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William Arbuthnot Lane

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BONE CHANGES IN THE SKULL IN DYSTROPHIA MYOTONICA

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Dystrophia myotonica [myotonia atrophica] is a hereditary-familial disorder which is transmitted by male and female alike and by both normal and affected individuals. When the mutation first makes its appearance in a family, cataract alone is found. In subsequent generations, the cataract usually occurs at an earlier age and is associated with other features of the fully developed disease picture such as muscle wasting, myotonia, areflexia and certain endocrinological changes of which the most constant is gonadal atrophy. Recent endocrine studies by Caughey and Brown (1950) suggest that the endocrine lesion is primarily a failure of the androgenic function of the adrenal cortex and of the gonads. In the same study these authors reported the radiographic abnormalities encountered in the skull in patients with dystrophia myotonica. In a subsequent paper, Caughey (1952) reported briefly thirteen patients with dystrophia myotonica, all members of the so-called " dystrophic generation," who presented similar radiographic changes. This paper is presented in order to bring the radiological aspect of this disease entity to the notice of orthopaedic surgeons. Patients with dystrophia myotonica may seek advice from an orthopaedic surgeon on account of the muscular dystrophy with characteristic myotonia, muscle wasting and areflexia, or possibly on account of bony changes in the skull. In the latter instance the differential diagnosis from Paget's disease, secondary carcinomatosis and other disorders of bone has to be considered.

HISTORICAL BACKGROUND

Myotonia was originally described by Leyden in 1874, and in 1892 Thomsen recorded in detail the myotonia from which he himself suffered. The association of muscle atrophy with myotonia was described by Dana in 1888. In 1909 Steinert recorded the full clinical picture and first described changes in the mental status and some of the associated dystrophic features such as premature frontal baldness and gonadal atrophy. At the time these latter findings were regarded as being merely coincidental. In 1911 Greenfield recorded the constant association of cataract with the disorder and thereafter the other dystrophic manifestations came to be recognised as variable features of the clinical picture in the fully developed disorder as seen in the so-called " dystrophic generation."

Few authors have referred to the radiographic changes in these patients. Scharnke and Full (1920) reported a large frontal sinus in the presence of a normal pituitary fossa. Rouquès (1931) reported radiographic abnormalities in the skull of four patients with the fully developed disorder. In three there was distinct thickening of the calvarium, large frontal sinuses occurred in two, in two the pituitary fossa was small and in two it was bridged by calcification. Fagin (1946) reported hyperostosis frontalis in two patients, and Correia de Oliveira and Mosinger (1951) discussed hyperostosis frontalis interna associated with the disease.

CLINICAL MATERIAL

In the past five years in New Zealand we have had the opportunity of studying twenty-four patients with dystrophia myotonica, nineteen with the fully developed disorder and five with cataract alone. Through the courtesy of General Dart of the Armed Forces Institute of Pathology, Washington, the author has had access to the records of a further case, and he has received details of another patient with the fully developed disorder from Dr Paul Yakovlev of Massachusetts. Out of the twenty-one cases with the fully developed disorder fifteen have shown changes in the skull, and these are here recorded.

CASE REPORTS

Case 1—Myopathy, myotonia, bilateral cataract, premature frontal baldness, hypogonadism, hypothyroidism, small pituitary fossa and hyperostosis frontalis.

Man aged forty-five years. Unmarried. Pensioner. At twenty-seven years he noticed wasting of his arms, legs and neck muscles. This had progressed and for three years he had been unable to raise his head from the pillow or to stand alone. He developed difficulty in relaxing his grasp five years after the onset and about the same time he developed bilateral lenticular opacities which were successfully treated five years later. Seven years after the onset he had to give up farming on account of the increasing weakness. Frontal baldness developed in his early twenties. Body hair had become soft and scanty over the past ten years.

Family history—One brother, aged forty-one, has bilateral lenticular opacities but no other evidence of the disease. An aunt on the maternal side has cataracts.

Physical examination—A tall, middle-aged man with frontal baldness, myopathic facies and scanty eyebrows, body hair and beard (Fig. 1). Facial hair was soft and scanty on the chin and moustache area. Pubic hair was of a female type of distribution, axillary hair was normal. The skin of his fingers was shiny and dystrophic in appearance. He was unable to sit unaided and required assistance when walking. Facial muscles were wasted and weak and there was almost complete atrophy of both sternomastoid muscles. There was wasting and weakness of all muscles of the forearms. The abdominal muscles were weak, and the lower limbs were wasted and weak in all movements. His gait was unsteady and "steppage" in type. When seen in 1936 there was myotonia of the grasp but, probably due to the excessive weakness, this is now slight. Mechanical myotonia was slight in the tongue, thenar and hypothenar eminences. All deep reflexes were lost. Sensory appreciation was normal. The testes were soft and very small. His mental state was good. The cardiovascular system was normal.

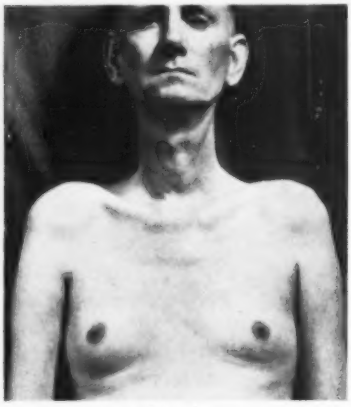

FIG. 1

Case 1—Myopathic facies; atrophy of sternomastoid muscles; gynaecomastia following implant of testosterone.

Investigations—The blood count was normal and the Kahn reaction negative. The cerebrospinal fluid was normal. Basal metabolic rate was −48 per cent and −34 per cent. The serum cholesterol was 360 milligrams/100 millilitres; total non-protein nitrogen 33 milligrams/100 millilitres; serum chlorides 556 milligrams/100 millilitres (as NaCl); serum calcium 10·7, 10·5, 9·1 milligrams/100 millilitres; serum phosphorus 4, 3·3 milligrams/100 millilitres; serum sodium 327 milligrams/100 millilitres; serum potassium 17 milligrams/100 millilitres; acid phosphatase 1·2 units; and alkaline phosphatase 22 K.A. units. The glucose tolerance test showed fasting blood sugar 98 milligrams/100 millilitres; subsequent levels were 125, 135, 139, 130 and 124 milligrams/100 millilitres at half-hourly intervals. Insulin tolerance test in 1947 was: fasting 100, 20 minutes 72, 30 minutes 41, 45 minutes 37, 60 minutes 77, 90 minutes 83, 120 minutes 98. The follicle-stimulating hormone test was positive to 96 mouse units. The test for adrenal cortical function (Cutler, Wilder, Power) gave an equivocal result. The 17-ketosteroid excretion was 1·3 and 1 milligram/100 millilitres in twenty-four hours. The electrocardiogram showed elevation of ST 1 and ST 2 and "slight ventricular myocardial damage seemed probable."

Radiographic findings—In the skull, the vault shape was normal and the calvarium thickened, with hyperostosis interna frontalis et parietalis. The sinuses were within normal limits. The pituitary fossa was small, with pneumatised dorsum sellae and the pineal body was calcified. The spine, pelvis and femora were normal.

Case 2—Myopathy, myotonia, bilateral cataract, frontal baldness, hypogonadism and small pituitary fossa.

Man aged forty-two years. Retired farmer. In 1941 he was aware of difficulty in relaxing his grasp, soon followed by weakness and wasting in his forearms, legs and neck muscles. The wasting and weakness have progressed and the myotonia has persisted. For four years there has been impairment of potentia and libido, with complete loss of potentia in the past six months, and he has become irritable and less reliable than previously.

Physical examination—A well-developed man with frontal baldness and myopathic facies. He had extensive body hair and normal facial hair. There was general wasting of his facial, temporal and sternomastoid muscles, the latter giving a rounded swan-like appearance to the neck. The deltoid muscles were hypertrophied but weak and there was severe wasting and weakness of his forearms and upper arms, the small muscles of the hands being unaffected. There was wasting of the legs and to a lesser extent of the thighs. All deep reflexes were absent. The grasp was myotonic and mechanical myotonia could be elicited from the tongue (Fig. 2), thenar, hypothenar and calf muscles. The visual acuity was reduced to six-twelfths in each eye, due to bilateral lenticular opacities. The testes were small and soft. The cardiovascular system was normal.
Investigations—The blood Kahn test was negative and a blood count normal. The serum calcium was 10·7 milligrams/100 millilitres; serum phosphorus 3·6 milligrams/100 millilitres; and serum cholesterol 180 milligrams/100 millilitres. The cerebrospinal fluid was normal. Basal metabolic rate was −12 per cent and −8 per cent. The electrocardiogram was normal. The glucose tolerance test was normal. Fasting blood sugar 80 milligrams/100 millilitres; subsequent levels: 115, 90, 75 and 70 milligrams/100 millilitres at half-hourly intervals. The insulin tolerance test was as follows: fasting 76 milligrams/100 millilitres; fasting 100, 20 minutes 80, 30 minutes 60, 45 minutes 66, 60 minutes 68, 90 minutes 102, 120 minutes 105, expressed as percentage of fasting value. Two 17-ketosteroid estimations were 2·5 and 4·5 milligrams excreted in twenty-four hours.
Radiographic findings—The chest was normal. Radiographs of the skull showed a normal vault. The frontal sinuses were extensive and the pituitary fossa was small. Femora and pelvis normal.

FIG. 2
Case 2—Mechanical myotonia of tongue after tapping with a percussion hammer.

Case 3—Myotonia, myopathy, auricular flutter, hyperostosis frontalis, very small pituitary fossa.

Man aged twenty-six years. Unmarried. Panel beater. In 1945 he developed palpitation and breathlessness and was admitted to hospital where auricular flutter was diagnosed. For two years previously he had noticed difficulty in relaxing his grasp, and weakness of his wrists and legs. Frontal baldness began to develop at twenty-one years of age. Sexual functions were unimpaired.
Physical examination—A slightly built man, with frontal baldness. Body hair and secondary sex hair were normal. The facies was myopathic and the neck rounded and swan-like due to wasting of his sternomastoid muscles. The forearms were wasted and the extensors of the wrists weak. The deep reflexes of the arms were absent; the knee jerks were reduced. There was myotonia of the grasp and mechanical myotonia of the tongue, thenar and hypothenar eminences, and the calves. The testes were normal. The visual acuity was normal and there were no lenticular opacities. Cardiovascular system: Pulse 110; blood pressure 115/85; the electrocardiogram showed an irregular rhythm with a 4 : 1 to 7 : 1 flutter; the ST segment was normal.
Investigations—The blood count was normal, and the Kahn reaction negative. Serum calcium was 10·4 milligrams/100 millilitres; serum phosphorus 3·2 milligrams/100 millilitres; and serum cholesterol 210 milligrams/100 millilitres. Basal metabolic rate was +38 per cent and +27 per cent. Acid phosphatase: 2 units. The glucose tolerance test showed fasting blood sugar 83 milligrams/100 millilitres; subsequent levels: 140, 96, 72, 82 milligrams/100 millilitres at half-hourly intervals. The insulin tolerance test was normal. Two 17-ketosteroid estimations were 4·2 and 5·5 milligrams excreted in twenty-four hours.
Radiographic examination—The chest was normal. The bones of the skull were thickened, especially in the posterior parietal region. There was also a hyperostosis interna, commencing in the frontal region. The frontal sinuses were deep. The pituitary fossa was very small.

Case 4—Myotonia, muscular dystrophy, bilateral cataract.

Woman aged thirty-three years. Married. Twelve years ago she noticed difficulty in relaxing her grasp and six or seven years later she noticed weakness and wasting of her right leg. Soon the weakness and atrophy became apparent in the left leg, upper limbs and in the neck and face. She then had difficulty in holding her back straight and at times had a tendency to overbalance. For three years she noticed deterioration of her vision and eighteen months ago the vision in the

right eye failed completely and a cataract was excised. The left eye subsequently failed and the cataract was removed. She has had three children. The first had a cleft palate and died of meningitis. The second had a cleft palate and hare-lip, and the third child is alive and well.

Physical examination—The facies was myopathic with wasting of all the facial musculature and the neck was swan-like due to complete wasting of the sternomastoids. There was wasting of the forearms with weakness more marked in the dorsiflexors of the wrists. The muscles of the legs were wasted and the dorsiflexors of the feet weak. The grip was myotonic and mechanical myotonia of the tongue, thenar and hypothenar eminences was present. All deep reflexes in the lower limbs were absent. There were bilateral lenticular opacities.

Radiographic examination (Fig. 3)—The skull vault shape was normal; the calvarium was markedly thickened throughout with marked hyperostosis frontalis interna and hyperostosis parietalis. The sinuses were within normal limits, with pneumatisation of the dorsum sellae. The pituitary fossa was small.

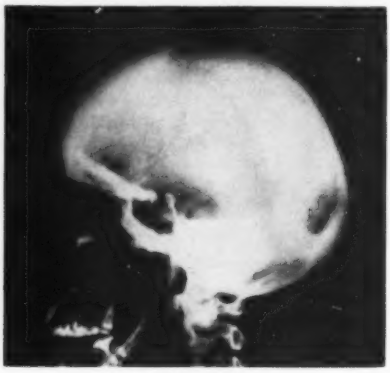

FIG. 3

Case 4—Thickened calvarium; hyperostosis frontalis et parietalis.

Case 5—Muscle wasting, myotonia, thickened calvarium and hyperostosis frontalis; small pituitary fossa.

Man aged twenty-seven years. The onset of his illness was two years ago when he first noticed difficulty in relaxing his grasp and noted wasting and weakness of the neck muscles and wasting of the forearms and legs. Frontal baldness was apparent in the early twenties.

Examination—He had frontal baldness and a myopathic facies; also myotonia of the grip and mechanical myotonia of the tongue, thenar, hypothenar and plantar muscles. There were no lenticular opacities. There was wasting of the muscles of the face, neck, forearms and legs. The reflexes were all present. There was no gonadal atrophy apparent.

Radiographic examination—The calvarium of the skull was thickened and there was hyperostosis interna frontalis. The sinuses were normal and the pituitary fossa small.

Case 6—Myotonia, myopathy, cataract, frontal baldness, calcification of falx cerebrium.

Man aged thirty-two years. Returned soldier. While a prisoner of war in Germany in 1944 he noticed difficulty in relaxing his grip, soon followed by wasting and weakness of the right shoulder muscles. Wasting progressed to involve the muscles of the face, neck, forearms, shoulder girdles and legs. His vision had recently deteriorated. There had been no impairment of potentia or libido.

Physical examination—He had frontal baldness and a myopathic facies with early wasting of the facial musculature. The sternomastoid muscles were completely wasted and there was wasting of the left deltoid and pectoral muscles, the spinati and trapezii muscles. The lower limbs were normal. There was myotonia of the grip and mechanical myotonia of the tongue, the thenar and hypothenar eminences, the deltoids and flexors of the forearms. The knee jerks were diminished and the right ankle jerk was absent. The visual acuity was unimpaired but both lenses showed early cataract with a few striae radiating from the posterior pole of the right eye and a few minute opacities in the left lens.

Investigations—A blood count was normal and the Wassermann reaction negative. The cerebrospinal fluid was normal. Serum calcium was 10·8 milligrams/100 millilitres and serum cholesterol 180 milligrams/100 millilitres. Excretion of 17-ketosteroids was 4·8 milligrams in twenty-four hours. Insulin sensitivity: fasting 100, 20 minutes 63, 30 minutes 45, 45 minutes 60, 60 minutes 67, 90 minutes 74, 120 minutes 127, expressed as percentage of fasting glucose level of 106 milligrams/100 millilitres. Biopsy from the left deltoid muscle showed irregular changes in the muscle fibres with some hypertrophic and many wasted fibres and an increase in the fibrous tissue. There was loss of transverse striations and multiplication of the nuclei.

Radiographic examination—Skull: the calvarium was normal. There was a calcified falx cerebri. No definite hyperostosis frontalis was present. The pituitary fossa was normal to small. All sinuses were large. Pelvis, femora and chest normal.

Case 7—Complete picture of dystrophia myotonica, with myotonia, wasting, cataracts, failure of potentia and libido, left bundle branch block, pituitary fossa small.

Man aged forty-one years. Carpenter. When thirty-four years of age he noticed failure of potentia which proceeded to complete loss of potentia and libido. Four years later, his grasp became difficult to relax and he developed weakness of his arms and legs, difficulty in swallowing and his speech became slurred.

Physical examination—A bald, wasted man with a myopathic facies. His speech was somewhat slurred and thick. The sternomastoid muscles were completely wasted. There was wasting and weakness of all four limbs. Voluntary myotonia affected the grasp of both hands and mechanical myotonia was present. All deep reflexes were absent. Secondary sex hair was scanty. The testes were small and soft and the prostate gland was very small. Visual acuity was normal. Slit lamp examination revealed multiple punctate subcapsular opacities longer and more numerous at the periphery. The pulse was slow and regular. The heart was normal. There was reduplication of the second sound at the apex. The blood pressure was 100/55.

Investigations—A blood count was normal and a blood Kahn test was negative. The cerebrospinal fluid was normal. The 17-ketosteroid excretion was 1·7 milligrams in twenty-four hours and a gastric test meal revealed a low total acidity. The electrocardiogram revealed a left bundle-branch block.

Radiographic examination—Skull: the vault was normal with well marked venous lacunae. The frontal sinuses and sphenoids were extensive and deep, the latter extending into the posterior clinoid processes. The mandible was elongated. The pituitary fossa was small. Pelvis and femora normal.

Case 8—Myopathy, myotonia, bilateral cataract, small pituitary fossa and hyperostosis frontalis.

Woman aged fifty-one years. Since the age of thirty years she had noticed weakness of her neck muscles. In the past five years there had been progressive wasting and weakness of her forearms and legs, so that she had been bedridden for a year. At times she had noticed some difficulty in relaxing her grasp, but this was not troublesome. Her vision had not failed noticeably, but there had been loss of libido for several years.

Family history—There are two sons, the younger son aged twenty-eight years having the fully developed disease. The elder son is well. There is no history of cataract in the family.

Physical examination—A middle-aged woman with grey hair, no baldness, and a myopathic facies. Her speech was slurred. Her body hair and eyebrows were somewhat scanty but of normal female distribution. The skin was soft and of fine texture. There was some wasting of the facial muscles. The sternomastoid muscles were almost completely atrophied and were powerless. There was great weakness and wasting of the forearms and legs. Mechanical and voluntary myotonia was only slight. All deep reflexes were reduced with absent ankle jerks. There were bilateral polar cataracts. The mental status was normal and she was of average intelligence. The cardiovascular system was normal.

Investigations—Serum calcium 10·3 milligrams/100 millilitres and serum phosphorus 4 milligrams/100 millilitres; serum sodium 335 milligrams/ 100 millilitres; serum chlorides 556 milligrams/100 millilitres (as NaCl); serum cholesterol 310 milligrams/100 millilitres. Glucose tolerance curve: 71, 96, 131, 148, 129 milligrams/100 millilitres at half-hourly intervals. Insulin sensitivity: fasting 100, 20 minutes 71, 30 minutes 55, 45 minutes 70, 60 minutes 73, 90 minutes 105, 120 minutes 117, expressed as percentage of fasting blood sugar. Follicle-stimulating hormone was strongly positive for 96 mouse units. The 17-ketosteroid excretion was 1·8 milligrams in twenty-four hours. The water excretion for adrenal cortical function suggested impaired function. The volume of the night urine was 435 cubic centimetres and that of the largest day specimen 315 cubic centimetres, giving a ratio of 38. Basal metabolic rate was −4 per cent. Electrocardiogram showed low voltages throughout and a left bundle-branch block and probably a first degree of heart block.

Radiographic examination—Skull: the vault was normal in shape but possibly large in size due to thickening of all the membrane bones. There was extensive hyperostosis frontalis interna (Fig. 4). The thickening was somewhat patchy and resembled that of Paget's disease. The sinuses and mandible were normal. The pituitary fossa was very small with calcification near the floor. There was no pneumatisation of the dorsum sellae. Chest, pelvis and femora normal.

Case 9—Myopathy, myotonia, cataract, hypogonadism, mental retardation, small pituitary fossa and hyperostosis frontalis.

Man aged twenty-eight years. Son of patient described in Case 8. At school was backward. On leaving school at thirteen years he was unable to hold any position. At seventeen he noticed difficulty in relaxing his grasp, soon followed by weakness and clumsiness of his arms, legs and

neck muscles. The weakness and wasting progressed slowly. For two years before our examination his vision had been deteriorating.

Physical examination—He was a dark, swarthy man of inferior intelligence. His facies was myopathic with a slow lingering smile. There was early recession of the hair in the frontal region, but his body hair was normal and of male distribution. His speech was slurred and indistinct. There was wasting of the sternomastoid muscles and of the muscles of the forearms and legs. There was marked myotonia of the grasp and, on percussion, of the tongue and small muscles of the hands. The knee and ankle jerks were absent. There was bilateral polar cataract. The testes were small and soft, but had normal sensation. The body dimensions were normal.

Investigations—The serum sodium was 332 milligrams and serum potassium 17·5 milligrams per 100 millilitres; the serum cholesterol 200 milligrams, serum calcium 9·9 milligrams and serum phosphorus 2·0 milligrams per 100 millilitres. The basal metabolic rate was +9 per cent. Glucose

FIG. 4

Case 8—Hyperostosis frontalis. Pituitary fossa small.

FIG. 5

Case 9—Hyperostosis frontalis et parietalis. Pituitary fossa small.

tolerance curve: 65, 120, 135, 130, 85 milligrams/100 millilitres at half-hourly intervals. Insulin sensitivity: fasting 100 (75), 20 minutes 80, 30 minutes 53, 45 minutes 80, 60 minutes 87, 90 minutes 75, 120 minutes 100, expressed as percentage of fasting blood sugar. The clinical response of the patient to insulin was normal. The 17-ketosteroid excretion was 1·2 milligrams in twenty-four hours. The water excretion test (Robinson, Power and Kepler 1941) produced 300 millilitres of night urine, and the greatest hourly volume of day urine after fluid was 210 millilitres, giving an index of 35. The excretion of follicle-stimulating hormone was positive to 96 mouse units. An electrocardiogram showed a P-R interval of 0·17 seconds, and a very small R wave in leads V2 and V3 with the probability of myocardial damage.

Radiographic examination—The skull vault was normal in size (Fig. 5); all the membrane bones were thickened, with extensive hyperostosis frontalis interna and hyperostosis parietalis interna. The sclerosis was patchy, to some extent resembling Paget's disease. The sinuses were extensive and deep. The pituitary fossa was very small, and the dorsum sellae thick and partly pneumatised. The pineal body was possibly calcified. Pelvis and femora normal.

Case 10—Myopathy, myotonia, hypogonadism, mental retardation and small pituitary fossa.

Man aged thirty-three years. Grocer. He had always been a frail individual. At school he was backward. His occupational history was unsatisfactory, and for the last year he had been unemployed. He had first noticed difficulty in relaxing his grasp when thirteen years of age. At the age of fifteen he had noticed that his arm and leg muscles were becoming weaker and were wasting. The difficulty with his grip had become increasingly great. He had begun shaving at twenty-one years and at thirty-three shaved every third day. His vision had not deteriorated.

Physical examination—He was a thin, swarthy man with a disinterested look, and below the average in intelligence. The head hair was dark, very fine and scanty, and the eyebrows were scanty. The facial hair was scanty and confined to the moustache and chin areas. The axillary and pubic hair were also scanty, the latter being of female distribution. The hair on his legs was fine but of normal distribution. His skin was dry and atrophic, with numerous melanomata. The thyroid gland was not palpable. There was marked myotonia of the grip, and myotonia of the

tongue and thenar eminences on percussion. The facies was myopathic, and there was wasting of the sternomastoids and, to a lesser degree, of the limb muscles. The deep reflexes were normal. No cataracts were present. The prostate gland was small. The cardiovascular system was normal.

Investigations—The blood Kahn test was negative. The serum sodium was 340 milligrams, serum potassium 16 milligrams and serum chloride 580 milligrams per 100 millilitres. The serum cholesterol was 280 milligrams and the serum calcium 10·1 milligrams per 100 millilitres. Glucose tolerance: 80, 160, 130, 130, 90 milligrams/100 millilitres at half-hourly intervals. Insulin sensitivity: fasting 100 (90), 20 minutes 72, 30 minutes 50, 45 minutes 78, 60 minutes 84, 90 minutes 89, 120 minutes 120, expressed as a percentage of fasting blood sugar. The clinical reaction to insulin was normal. The 17-ketosteroid excretion was 3·1 milligrams in twenty-four hours. The water excretion test (Robinson, Power and Kepler 1941) produced 360 millilitres of night urine, and the greatest hourly day urine after fluid was 270 millilitres, giving an index of 31. Excretion of follicle-stimulating

FIG. 6

Case 10—Skull small; mandible elongated. Pituitary fossa very small.

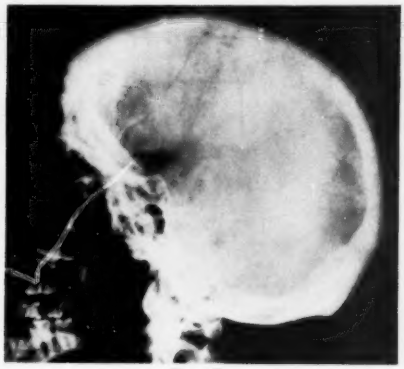

FIG. 7

Case 14–Thickening of the calvarium; hyperostosis frontalis. Pituitary fossa small and bridged over.

hormone was positive to 96 mouse units. An electrocardiogram showed some slurring of R in leads I and II, probably representative of myocardial damage.

Radiographic examination—The skull (Fig. 6) showed a small, globoid and microcephalic vault. The bones were thick but of normal density, with marked venous lacunae. The sinuses were extensive and deep, especially the sphenoids, which extended into the posterior clinoid processes. The mandible was elongated. The pituitary fossa was very small. The dorsum sellae was pneumatised.

Case 11—Myotonia, myopathy, cataract, hyperostosis interna frontalis, pituitary fossa small, mental defect.

Woman aged forty-five. Unmarried. She was committed to a mental hospital nine years ago on account of mental defect. Three years ago she first noticed difficulty in relaxing her grasp and a year ago first developed bilateral cataracts and noticed gradual wasting of the face, neck, forearm and leg muscles.

Examination—A slight, poorly nourished woman with a myopathic facies. Cataract in left eye and cataract recently removed from the right eye. The facial muscles were wasted and there was marked wasting of the sternomastoid muscles and wasting of the forearms and legs. There was well marked myotonia.

Radiographic examination—The skull showed marked hyperostosis interna frontalis. The floor of the anterior fossa was more vertical than usual and the pituitary fossa was small. The sphenoidal sinus was large and the antra natural. The jaw was prognathic.

Case 12—Bilateral cataract, myotonia, weakness of sternomastoids, thickened calvarium, hyperostosis frontalis, pituitary fossa small.

Married woman aged forty-seven years. Had developed bilateral cataract nine years previously.

Physical examination—There was well marked myotonia of grasp and mechanical myotonia of the tongue and thenar and hypothenar eminences. The sternomastoid muscles were weak but there was no wasting of muscles apparent.

Radiographic examination—Skull: the calvarium was thickened and there was hyperostosis interna frontalis. The pituitary fossa was small. The sinuses were all normal.

Case 13—Myotonia, myopathy, calvarium thickened, hyperostosis frontalis, pituitary fossa small.

Woman aged forty-two. Unmarried. Cousin of previous patient (Case 12). For fifteen years she had noticed inability to relax her grasp. For fifteen months wasting and weakness of her legs. *Physical examination*—There was a myopathic facies and wasting of the sternomastoid muscles and of the muscles of the forearms and legs. There was myotonia of grasp and mechanical myotonia of the thenar and hypothenar eminences.

Radiographic examination—Skull: there is marked thickening of the calvarium, the average thickening being approximately 1½ centimetres. The thickness is evenly distributed and involves all the bones of the vault. There is also hyperostosis interna frontalis. The pituitary fossa is small.

Case 14—Bilateral cataract, myopathy, gonadal atrophy, hyperostosis frontalis and small pituitary fossa.

Man aged fifty-two years. Admitted to hospital on account of weakness of his legs and inability to walk for five years. Since 1931 he stated that his legs kept "giving away." He had not worked since 1931 and for five years had been bedridden. His vision had been defective for years.

FIG. 8

Case 15—Wasting of sternomastoid muscles, forearms and legs. Jaw prognathic.

Physical examination—A pale man with a myopathic facies. Visual acuity was much reduced by bilateral cataract. There was marked wasting and weakness of the sternomastoid muscles and of the forearms and legs. All deep reflexes were lost. Cardiovascular system was normal. Blood pressure 155/100. There was no record of myotonia.

Family history—Two brothers suffer from similar disabilities.

Investigations—Kahn negative. Cholesterol 262 milligrams per cent. Creatinine 1·4 milligrams per cent. Creatine 4·6 milligrams per cent.

Radiographic examination—Skull: there was considerable thickening of all the bones of the vault, particularly in the frontal area where there is definite hyperostosis interna (Fig. 7). The pituitary fossa was small and almost bridged over.

Case 15—Myotonia, myopathy, hypogonadism, acromegaloid features, hyperostosis frontalis.

Man aged forty-three years. He was feeble-minded, with a mental age of seven years and intelligence quotient 44. His mother was said to be feeble-minded. Two siblings were both feeble-minded and with dystrophia myotonica. At seventeen patient was admitted to a farm colony in Connecticut on account of frequent falls and repeated fractures of the long bones.

Physical examination—The lower jaw was prognathic (Fig. 8). He had myotonia of the grip of both hands and mechanical myotonia of the adductor pollicis. There was gross muscle wasting of the temporal, masseter, sternomastoid, forearm and leg muscles. The knee jerks and ankle jerks were absent. There was testicular atrophy and gynaecomastia.

Post-mortem examination confirmed the clinical diagnosis of dystrophia myotonica. The skull showed severe hyperostosis frontalis interna. The inner table of the frontal bone was thickened by solid bony irregular smooth-surfaced excrescences symmetrically distributed on each side of the midline. In the area of endostosis the frontal sinuses extended deep into the frontal bone. The pituitary gland was large especially in transverse diameter which measured 24 millimetres. Its antero-posterior length was 13 millimetres, and weight 1·1 grammes. Both testicles were small and soft.

DISCUSSION

These fifteen patients (ten male and five female) had dystrophia myotonica with the fully developed disorder. In all there were radiographic abnormalities of the skull. There was thickening of the calvarium in eleven patients and hyperostosis interna occurred in eleven. This was more marked in the frontal region but occurred in the parietal region in five patients. In one the hyperostosis was more apparent in the parietal region. In eight patients the

frontal sinuses were extensive and deep, and in six there was extensive pneumatisation of the sphenoidal bone.

The assessment of size of pituitary fossa is notably difficult and in the above reports it is classified as normal, small, or very small. "Small" indicates a sagittal diameter below 9 millimetres and/or a vertical diameter below 6 millimetres; "very small" indicates measurements below 6 millimetres and/or 4 millimetres respectively for the same diameters. With four exceptions the magnification distortion was known to be the same in the cases examined. In the series the pituitary fossa was small in eight cases, very small in five and normal to small in one. In one case no radiographs of the skull were available but post-mortem revealed a somewhat enlarged pituitary fossa.

The jaw was prognathic in three and in one it was sufficiently large to be classified as acromegaloid. In this patient post-mortem examination showed the pituitary fossa to be enlarged; the pituitary gland was small and it seemed likely that it must have been enlarged at one time and subsequently undergone atrophy. These acromegaloid features and the extensive sinuses suggest an overactivity of the anterior pituitary gland at some time in the course of the disorder in spite of the apparent paradox of the associated small pituitary fossae.

In one patient there was well marked calcification of the falx cerebri and this has since been observed in two other cases. In Case 1 a full check of other parts of the skeleton failed to reveal any abnormalities. In two others the chest radiographs were normal, and in five the pelvic bones and femora were normal.

It is evident that thickening of the calvarium, hyperostosis interna, a small pituitary fossa and extensive sinuses are some of the variable dystrophic features of dystrophia myotonica.

SUMMARY

Fourteen patients with dystrophia myotonica and a post-mortem report of another case are reported. All had radiological or other evidence of abnormalities of the skull. The most constant were a thickened calvarium, hyperostosis interna, small to very small pituitary fossa and extensive sinuses. It is believed that the high incidence of these changes cannot be coincidental and it is held that they should be accepted as some of the variable features of dystrophia myotonica.

For records and photograph of Case 14, I am greatly indebted to the Director of the Armed Forces Institute of Pathology, Washington, D.C., and for Case 15 I am indebted to Dr Paul Yakovlev and Dr Wadsworth of the Connecticut State Hospital. It is also a pleasure to thank other physicians who have given me access to their cases.

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DEFORMITY OF THE ELBOW JOINT AS A SEQUEL TO ERB'S OBSTETRICAL PARALYSIS

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The discovery some years ago of several instances of posterior dislocation of the radial head in children who had been treated in infancy for Erb's obstetrical paralysis prompted a survey of the literature on associated elbow deformities. References were not found to be plentiful and in many the condition was dismissed as an uncommon and unimportant complication apparently confined to the older child. Attention has been focused almost entirely upon deformities of the shoulder region.

EARLIER CLINICAL REPORTS

There were, however, a few most interesting statements. Bullard (1907) stated that in some old cases extension of the elbow was limited. He showed a radiograph of a posteriorly dislocated radial head of a child of about six years. Thomas (1914), reporting nine old cases of Erb's paralysis, mentioned that in several with limited elbow movements there was "undue prominence" of the radial head, but this finding was not enlarged upon. Sever (1925), in a series of 1,100 cases of Erb's palsy, found that subluxation or dislocation of the radial head had occurred in many instances. Gilmour (1925) mentioned that limitation of elbow movements and radial head subluxations occur in a particular type of paralysis, and suggested that the subluxation is due to the combined paralysis of the supinators and the action of pronator teres. Jepson (1930) stated that, in the older patient, extension of the forearm on the arm is often impaired, but that "no bony deformities are to be found radiologically, at any rate in the first year of life."

McFarland (1936), describing a series of eleven anterior dislocations of the radial head in children, unassociated with paralysis or trauma, considered that the deformity was congenital in origin, as distinct from "subluxations of the radial head occurring in Erb's paralysis as a result of muscle imbalance." Radiologically, the appearances of his cases are identical in every detail with the anterior dislocations in this series, but, judging from the findings to be set out later in this paper, his description of this condition as congenital is possibly incorrect in some cases.

Morison (1938) stated that in his series of twenty-eight cases of Erb's palsy, although more than half had deficient extension of the elbow and deficient supination, no bony changes were found radiologically. Moore (1939) considered that "contractures in turn lead to joint deformities, especially in the shoulder, where a subluxation is often seen, and in the elbow, where a displacement of the radial head is seen."

CLINICAL MATERIAL

It is well known that nerve injury in growing children may result in alterations of bone growth and consequent deformity. It was therefore expected that in a condition such as Erb's obstetrical paralysis, in which the causative factors are present from birth, these changes would be well marked, and that the study of a large series of cases would confirm this hypothesis. Accordingly a review of all patients with Erb's obstetrical paralysis attending the Royal Hospital for Sick Children, Glasgow, over the past fifteen years was undertaken. It was hoped to arrive at conclusions concerning the incidence, etiology, treatment and, in particular, the possibility of preventing deformity of the elbow.

Eighty-seven cases of Erb's obstetrical paralysis were examined during this survey and a further twenty patients have attended since the investigation began and are included in the series, bringing the total to 107 cases. This paper reports thirty-three cases of bony deformity of the elbow region, an incidence of 30·8 per cent of the series.

OBSERVATIONS

The investigation revealed the following facts. The displacement of the radial head may be anterior or posterior; the former is a simple dislocation which may or may not be associated with Erb's paralysis; the latter starts as a subluxation but in the older child amounts to complete dislocation. Both types are associated with less obvious deformities of the other

TABLE I

ANALYSIS OF LESIONS AND CLASSIFICATION INTO TYPES

Pathology	Recovery	Criteria for grouping		Average time of splinting	Eighty-seven cases		
		Muscles	Growth, etc.		No.	Posterior dislocation	Anterior dislocation
MILD							
Type 1							
Stretching of plexus, with or without absorption of resulting haemorrhage	Complete	No residual signs or symptoms	Normal	3 months to 6 months	17 (20%)	0	0
	Good	Slight weakness	Normal		29 (33%)	0	2
MODERATE							
Type 2							
Rupture of a few fibres with haemorrhage	Fair to poor	Definite weakness Mild degree of contracture	Affected limb shorter than the normal by ½ to 1½ inches	6 months to 12 months	25 (29%)	18	2
SEVERE							
Type 3							
Rupture of many fibres with haemorrhage or avulsion	Poor to minimal	Residual paralysis Definite to severe contractures	Affected limb shorter than the normal by more than 1½ inches. Muscular wasting. Trophic and sensory disturbance	Indefinite	16 (18%)	3	1
Cases still under treatment—unclassified					20	6	1

bones taking part in the elbow joint. The incidence of the two types was: Posterior type—twenty-seven cases (25·4 per cent); anterior type—six cases (5·6 per cent). The posterior type is not a simple dislocation or subluxation of a normal radial head occurring in the older child as suggested in the literature, but commences in infancy and is associated with altered bony growth. Evidence of bony malformation and of incipient posterior subluxation of the radial head can be seen radiographically as early as two months of age, long before there is any clinical evidence of deformity. In the older child limitation of active and passive movement is a marked feature and is much more pronounced than is warranted by the degree of residual paralysis or the presence of contractures.

Classification (Table I)—The following classification has been adopted in order to correlate the incidence of displacement of the radial head with the degree of paralysis and subsequent recovery, and period of splinting. *Type* 1—Mild lesion. Complete or good recovery. Failure of conduction is due to stretching of the nerve fibres and associated perineural haemorrhage.

This haemorrhage may be absorbed and recovery is then early and complete. If cicatrisation of the haematoma occurs, recovery is slower, and is incomplete to a variable degree. Normal growth of the limb occurs in patients in this first group. *Type* 2—Moderate lesion. Fair or poor recovery. Failure of conduction is due to stretching of some nerve fibres and tearing of others, with associated intra- and extra-neural haemorrhage. Recovery is slow and incomplete to a varying degree, depending on the number and situation of the fibres involved. Frequently in this type there is a " neuritis " of the plexus causing irritability and tenderness of the non-paralysed muscles. Tenderness can also be elicited in the neck over the plexus itself. The arm is held firmly in the classical position by spasm of these muscles. This " neuritis " is probably due to irritation caused by haemorrhage between the frayed-out nerve fibres. In this group interference with the nutrition of the limb is demonstrated at an early age by imperfect ossification and slowing up of growth of the bones, by delay in the appearance of the abnormally small epiphysial centres, and later by their late fusion with the metaphysis and with one another. *Type* 3—Severe lesion. Poor or minimal recovery. Failure of conduction is due to complete or almost complete rupture of the upper trunk of the plexus at " Erb's point " or, in the most severe cases, to actual avulsion of the nerve roots of C.5 and C.6 from the spinal cord. Recovery is minimal or nil. The bones are porotic, smaller than normal in all dimensions, and epiphysial ossification and fusion are much delayed. *Incidence of recovery*—The period of treatment depends directly upon the extent of the lesion. It appears to be agreed that if recovery is to be complete it will be so after three to six months of treatment (Fairbank 1913, Taylor 1920, Jepson 1930), and that cases requiring up to one year of treatment make a fair recovery, whereas those who require longer than one year show only minimal improvement over their original condition. In the present series about 50 per cent were of Type 1 (but only seventeen out of 106 recovered completely), about 30 per cent of Type 2 and about 20 per cent of Type 3. A detailed analysis is shown in Table I.

Before this investigation treatment had been along the lines suggested by Fairbank in 1913, its object being to relax paralysed muscles and prevent contractures of the unopposed muscle groups. Active and purposeful movements were encouraged as soon as possible. The splint was discarded during the day and reapplied at night when the following conditions were fulfilled: 1) when the infant could raise his arm from the splint; 2) when the lateral rotators of the shoulder had recovered sufficiently to balance the medial rotators; and 3) when the flexors of the elbow were capable of voluntary contraction. The splint was discarded completely only when recovery was well advanced, and thereafter physiotherapy was continued until the child was some years old, depending on the amount of recovery.

NATURE OF THE DEFORMITY

Table II lists the twenty-seven cases of posterior radial displacement with particular details of splinting, in order to show that there were no neglected cases, that treatment was not begun at an unduly late date, but that the length of time of splinting appears unduly prolonged in many cases. It will be seen that the displacement was noticed at an early age in the first six cases. This early recognition was due to the institution of routine radiographic examination, by which it was found possible to recognise bony changes not only in the radius but also in the ulna before any bony abnormality was discernible clinically. Cases 25, 26 and 27 were those which directed attention to the dislocation.

An anterior dislocation was present in only six patients. This type does not follow any standard pattern nor is it apparently related to any set of factors.

Fairly early in the investigation it appeared that posterior dislocations occurred mainly in patients immediately above and below the dividing " line " between Type 2 and Type 3 cases—that is, the more severely affected of the patients of Type 2 and the milder of Type 3. In short, it appeared that the degree of paralysis had to be greater than would admit of

TABLE II

CLINICAL DETAILS IN TWENTY-SEVEN CASES OF POSTERIOR DISPLACEMENT OF THE HEAD OF THE RADIUS (SUBLUXATIONS AND DISLOCATIONS)

Case number	Sex	Side affected	Age at first visit (Splint applied one week later)	Total period of splinting	Age at discovery of bony deformity	Present age	Result	Remarks
1	M	L	1 day	7 months	7 weeks	7 months	Good	Treatment and splint altered at age of discovery of deformity by radiography
2	F	R	16 days	5½ months	2 months	6 months	Good	
3	M	L	3 weeks	8 months	4 months	9 months	Good	
4	M	L	3 weeks	10 months	4 months	11 months	Fair	
5	F	L	3 weeks	10 months	7 months	11 months	Good	
6	M	L	9 days	11 months	3 months	1 1/2 years	Good	
7	M	L	4 days	10 months	1 year	1 1/2 years	Fair	
8	M	R	3 weeks	1 year	1 1/2 years	1 1/2 years	Fair	
9	M	L	5 days	1½ years	2 1/2 years	2 1/2 years	Fair	
10	F	R	2 weeks	11 months	3 years	3 years	Fair	
11	F	R	3 weeks	1 5/12 years	3½ years	3½ years	Fair	
12	M	L	10 weeks	1 year	5 years	5 years	Bad	
13	M	L	8 days	1 5/12 years	5 years	5 years	Fair	
14	M	L	8 days	1 1/2 years	6 years	6 years	Fair	
15	F	R	2 weeks	1 1/2 years	6 1/2 years	6½ years	Fair	
16	F	R	4 days	1 year	7 years	7 years	Fair	
17	F	R	11 days	7 months	7 years	7 years	Fair	
18	M	R	3 weeks	7 months	7 years	7 years	Fair	
19	F	L	1 day	1 year	7 years	7 years	Fair	
20	M	R	2 weeks	11 months	8 years	8 years	Fair	
21	M	R	2 weeks	1 year	8 years	8 years	Bad	
22	F	R	11 days	10 months	10 years	10 years	Fair	
23	F	R	10 days	Did not report again. ? Splint for 10 months		15 years	Fair	
24	M	R	Treated elsewhere. Added for completeness			30 years	Bad	
25	M	L	2 weeks	1 year	6 years	Radial heads removed when deformity discovered. First cases seen, fair before and after operation		
26	M	R	3 weeks	1 5/12 years	6½ years			
27	M	L	8 days	11 months	7 years			

complete or nearly complete recovery, but not so severe as to preclude some recovery. This observation has been confirmed by the final analysis. Patients with an "irritative neuritis" are specially prone to develop the radial and ulnar changes; moreover, no instance was encountered of the deformity arising in a neglected or untreated patient.

Once attention had been focused on these points it became a matter of great interest

to detect the earliest possible changes and to prevent their progress. Early detection clinically was difficult because of the natural non-co-operation of little babies. But muscle spasm, resistance to passive movements (such as application of splint), and tenderness of the plexus were regarded seriously, and called for radiographic examination.

Radiologically the impending displacement could be detected with certainty. The

FIG. 1

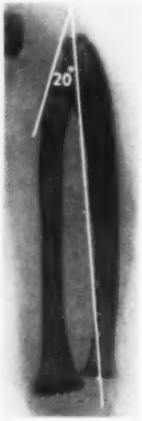

FIG. 2

FIG. 3

Determination of exaggerated ulnar curve. In Figures 1 and 2 the trochlear notch-shaft angle has been measured Figure 1 showing the normal arm. In Figure 3 the radiographic shadows of the two ulnae have been superimposed.

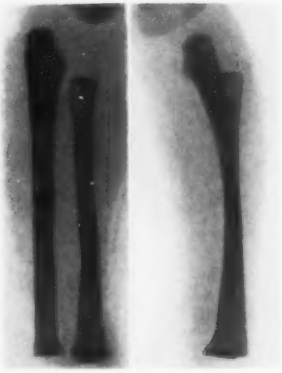

FIG. 4

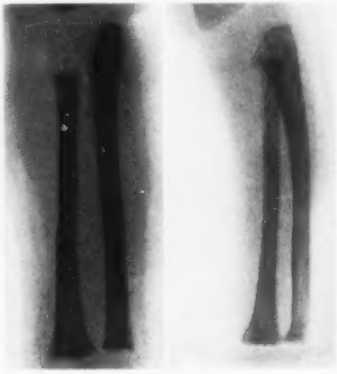

FIG. 5

FIG. 6

Case 1—Figure 4 shows the appearance of the deformity in an infant of seven weeks with Erb's paralysis on the left side. Figure 5 shows the normal arm for comparison. In Figure 6 the shadows of the ulnae have been superimposed.

significant changes are set out in Figures 1 to 26, and the ultimate state is shown in Figure 28. The progression is illustrated diagrammatically in Figure 29. Briefly the changes are as follows. 1) There is clubbing of the upper radial metaphysis followed by notching of its anterior aspect. (It must be remembered that the epiphyses are translucent and changes in them will not be shown radiographically.) Increased ulnar curvature and slight backward displacement of the

upper end of the radius are noted, and there is deficient growth of bones as shown by the small capitular centre. These changes are observed from birth up to seven months.

2) As age increases the radial displacement and ulnar curve become more marked and, in addition, the upper radial metaphysial line becomes oblique from before backwards and upwards due to spreading of the notch in a distal direction. A second curve, concave

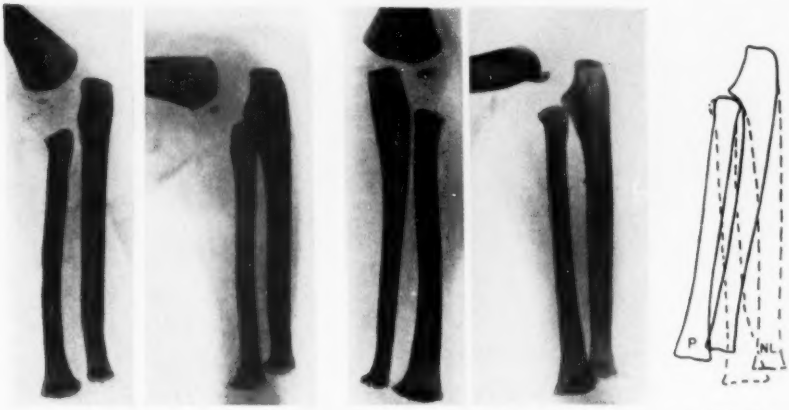

FIG. 7 FIG. 8 FIG. 9

Case 2. Figure 7—Appearance of deformity in an infant of two months with Erb's paralysis on the right side. Note the small capitular epiphysis and slight backward displacement of upper end of radius. Figure 8 shows the normal left arm for comparison. In Figure 9 the shadows of the forearm bones have been superimposed.

FIG. 10 FIG. 11 FIG. 12

Case 5. Figure 10—Appearance of the deformity in an infant of seven months with left Erb's paralysis. Inset shows details of the notch in the radial metaphysis. Figure 11—Normal arm. In Figure 12 the shadows of the forearm bones of the two arms have been superimposed.

posteriorly, appears in the distal part of the ulna and this is in line with the posteriorly displaced radial axis.

3) Between the ages of five and eight years the head becomes completely dislocated. The radius appears much too long and the capitular centre begins to flatten where it articulates with the displaced head.

4) Finally, between eight and fourteen years, a conical epiphysial centre appears for the radial head and this articulates with the flattened capitulum by its anterior surface.

CAUSES OF THE DEFORMITY

It was obviously advisable to determine the factors causing the initial exaggeration of the ulnar curve and the clubbed metaphyses in order to institute early treatment, as it is

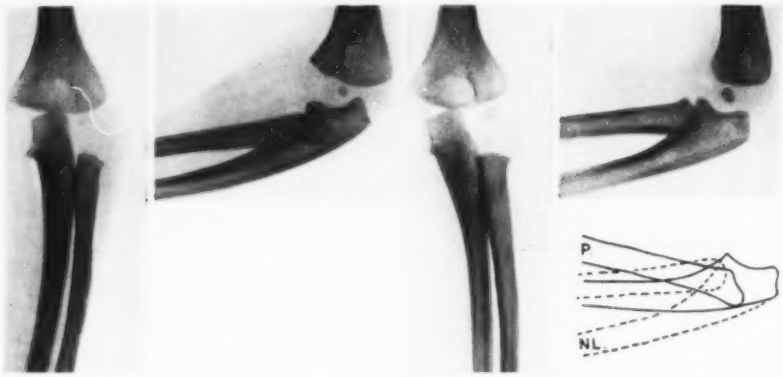

FIG. 13 FIG. 14 FIG. 15

Case 8. Figure 13.—Appearance of the deformity in a child aged two years, with right Erb's paralysis. Figure 14 shows the normal arm for comparison. In Figure 15 tracings of the radiographs are superimposed.

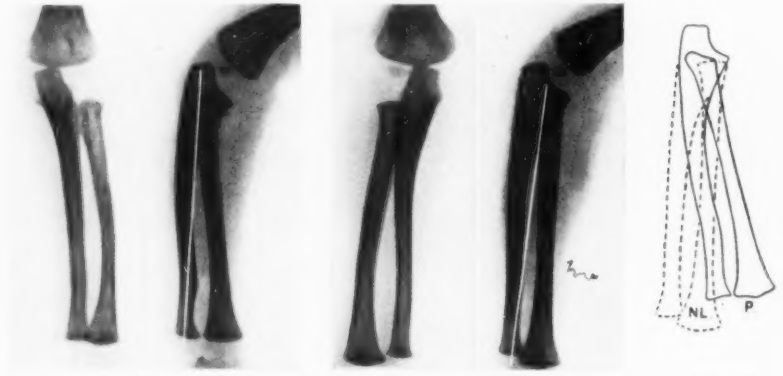

FIG. 16 FIG. 17 FIG. 18

Case 10. Figure 16.—Appearance of the deformity in a child aged three years with right Erb's paralysis. Note posterior displacement of axis of radius and curve of distal third of ulna, corresponding to it. Figure 17 shows the normal side for comparison. In Figure 18 radiographs of both forearms are superimposed.

the patients with this increased curve who subsequently develop the radial dislocation. From my observations of the series I believe that these deformities are caused by forcing the upper limb, some muscles of which are spastic and others paralysed, into a too fully "corrected" position imposed by the Fairbank type of splint, and by retaining it thus over an unduly long period. It may be that forcing flexion at the elbow against the pull of the spastic triceps, with absence of a balancing biceps and brachialis pull, initiates the curvature of the ulna (Fig. 30). It may be that by forcing supination against the pull of the spastic

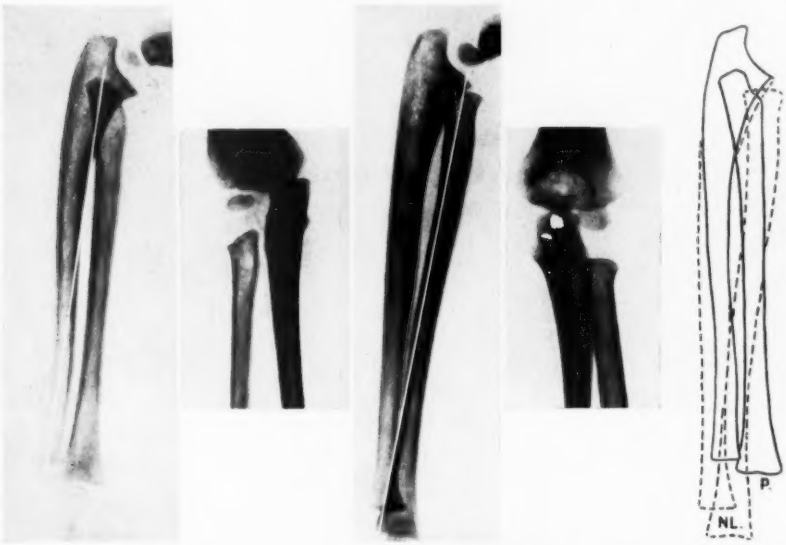

FIG. 19 FIG. 20 FIG. 21

Case 12. Figure 19—Appearance of the deformity in child aged five years with left Erb's paralysis. Axis of radius displaced as before. Figure 20—Normal forearm. Figure 21—Tracings superimposed.

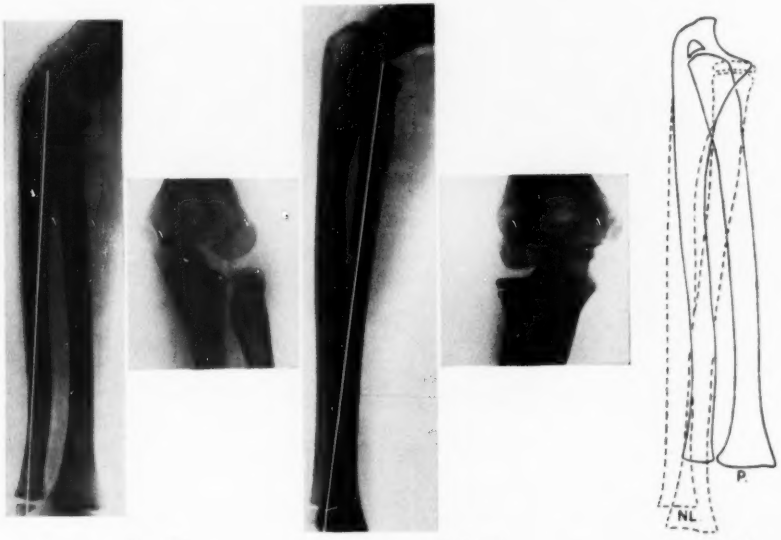

FIG. 22 FIG. 23 FIG. 24

Case 20. Figure 22—Appearance of the deformity in a child aged eight years with right Erb's paralysis. Axis of radius displaced as before. Figure 23—Normal left forearm shown for comparison. Figure 24—Tracings superimposed.

pronator teres, pressure is set up in the axis of the upper radius (Fig. 31). In response to this pressure of the radial epiphysis against that of the capitulum, the metaphysis first becomes thicker or clubbed, and then is moulded obliquely as noted in my cases. The total effect of these forces is enhanced by the abnormal malleability of the bones, by laxity of atrophic ligaments due to disuse and poor blood supply, and by paralysis of some of those muscles

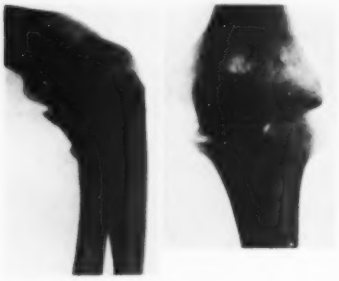

FIG. 25

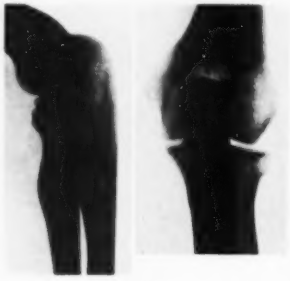

FIG. 26

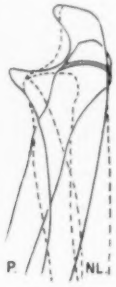

FIG. 27

Case 23. Figure 25—Appearance of the deformity in a child aged fifteen years with right Erb's paralysis. Figure 26—Normal left elbow shown for comparison. Figure 27—Tracings of the two elbows superimposed.

FIG. 28

Radiographic appearance in the adult.

which aid joint stability by their tone. This process is comparable to the findings of Appleton (1934), who stated that in immature rabbits increased pressure on a metaphysis is sufficient to hinder growth in length in the direction of pressure, and that excessive growth may occur at right angles to the direction of pressure.

The subluxation is thus gradually produced by bone growth and by relative contracture of the pronator and allied structures, one of which is the interosseous membrane, which now

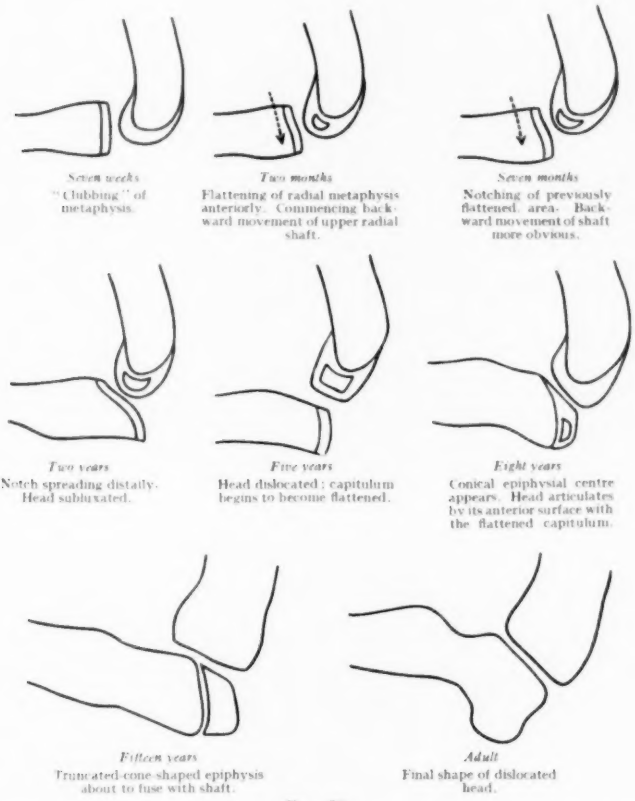
Seven weeks
"Clubbing" of metaphysis.
Two months
Flattening of radial metaphysis anteriorly. Commencing backward movement of upper radial shaft.
Seven months
Notching of previously flattened area. Backward movement of shaft more obvious.
Two years
Notch spreading distally. Head subluxated.
Five years
Head dislocated; capitulum begins to become flattened.
Eight years
Conical epiphysial centre appears. Head articulates by its anterior surface with the flattened capitulum.
Fifteen years
Truncated-cone-shaped epiphysis about to fuse with shaft.
Adult
Final shape of dislocated head.

FIG. 29

Serial diagrams showing the changes in shape of the head of the radius as age advances.

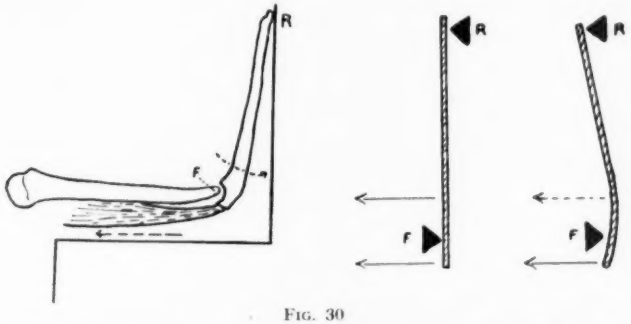

FIG. 30

Possible causation of ulnar curvature by imbalance between the spastic triceps and the paralysed biceps and brachialis, combined with firm corrective splinting.

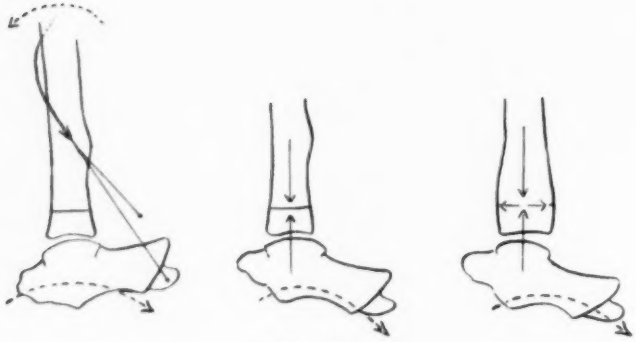

FIG. 31

Possible causation of the clubbed radial metaphysis. The articular end of the humerus is represented with the radius at right angles to it as in the Fairbank splint. The capitulum is pressed against the radial head by the constant pull of the spastic medial rotators, opposed by the vertical limb of the splint against the ulnar side of the forearm. Head pressed against the capitulum by the "screw-home" action of forced supination against a spastic pronator. Growth diminished in long axis but increased transversely causing "clubbing" of the metaphysis.

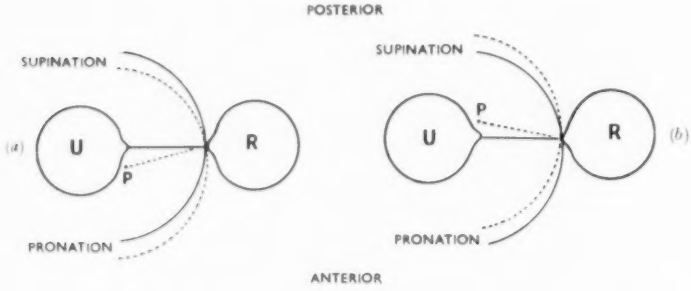

FIG. 32

Reversal of role of interosseous membrane due to posterior displacement of radial axis. P = position of the radial axis. (*a*) represents normal cases and (*b*) cases with subluxation of radial head.

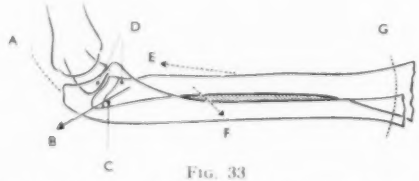

FIG. 33

Forces causing the ulnar curve, notching of the metaphysis and early subluxation. A = triceps. B = resultant force. C = normal growth and direction of ulnar curve. D = restricted growth. E = pull by pronator teres. F = pull by interosseous membrane. G = splint.

reverses its role and tightens on supination owing to the posterior displacement of the radial axis (Fig. 32) (Patrick 1946). This alteration in the function of the interosseous membrane causes the ulna to become curved in its distal part, to which the membrane is attached, by traction during supination and pronation. The double curvature then makes the ulna relatively shorter than the radius, which consequently appears too long. The combined effects of these forces are shown in Figure 33. The various limitations of movement noted by all observers can now be rationalised and an attempt to do this is shown in Table III.

TABLE III

ETIOLOGY OF LIMITATIONS OF MOVEMENTS

Movement	0–1 year	1–4 years	4 years ownards
EXTENSION OF ELBOW: Active	Exaggeration of curvature of upper fourth of ulna	Ulnar curvature Contracture of anterior capsular ligaments	Ulnar curvature Capsular contracture Dislocation of radial head
Passive	Limited by 15° to 20°	Limited by 20° to 25°	Limited by 25° or more
FLEXION OF ELBOW	Paralysis of biceps and brachialis	Paresis of biceps and brachialis Contracture of triceps.	Weakness of biceps and brachialis Contractures of triceps and capsule
SUPINATION Active	Paralysis of supinators	Displaced radial axis Early pronator contracture	Displaced radial axis Pronator contracture Dislocated radial head
Passive	Full—180°	Limited by 80°	Limited by 130° to 175°

Anterior dislocation—The foregoing observations on the causes of posterior dislocation cannot apply to the anterior dislocation. I suggest that these latter are due to traction by the obstetrician on the hand. In other words " pulled elbow " (White 1943) is caused during birth. This may well be the explanation of some of McFarland's so-called " congenital dislocations " which so closely resemble the anterior dislocations in my series.

PREVENTIVE TREATMENT

In the light of these observations it was reasonable to change the treatment of patients who were exhibiting signs of impending displacement or who were of a type likely to develop it. Accordingly, as soon as it was clear that subluxation was a possibility, an abduction splint which only half-flexed the elbow and which supported the forearm in mid-pronation, was fitted (Fig. 34). Thrice daily the splint is removed and all joints of the arm are put through their full range of movement (by the parent). As soon as the biceps and brachialis are working, the splint is discarded during the day, and when general recovery is satisfactory it is discarded altogether. The passive movements are continued until the child can do them himself in the form of exercises.

Patients shown as Cases 1 to 6 in Table II have been treated in this way since the very early detection of adverse factors. The posterior ulnar curvature is now much less exaggerated and there is practically full active and passive extension of the elbow and pronation and supination of the forearm. There is, however, still some " clubbing " of the upper radial metaphysis, though this is not apparently progressing to subluxation and still less to dislocation.

All cases of Erb's paralysis now under the care of our clinic are treated in the foregoing manner. The impression is that results are much improved. No new case of incipient subluxation has been seen.

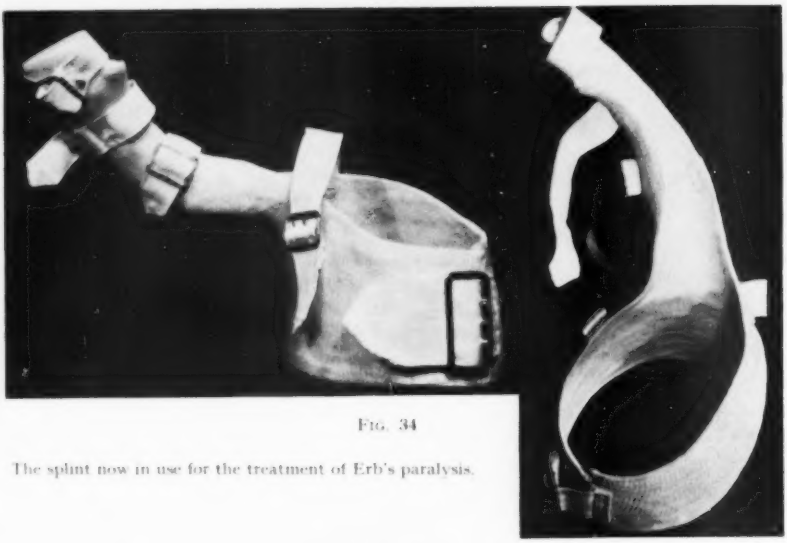

FIG. 34

The splint now in use for the treatment of Erb's paralysis.

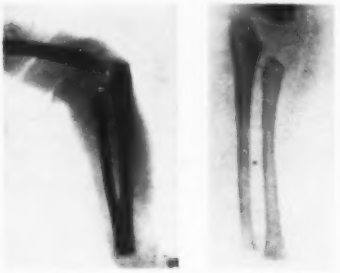

FIG. 35

FIG. 36

FIG. 37

Case 28. Figure 35—Anterior dislocation of upper end of radius in an infant aged two weeks. Case 30—Anterior dislocation of head of radius. Figure 36—At age of four months. Figure 37—At age of eleven years. Note reversal of the ulnar curve and the abnormal radial epiphysis.

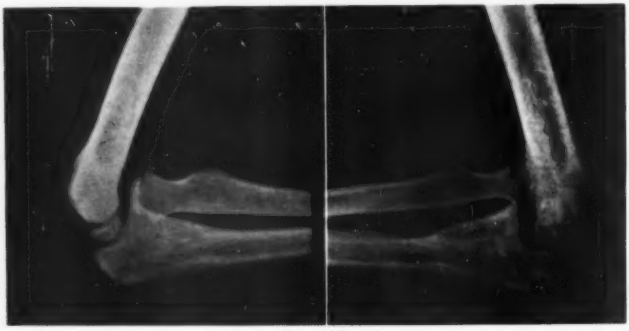

FIG. 38

Bilateral anterior dislocation of the head of the radius (Professor McFarland's case). For comparison with anterior dislocations of this series.

TREATMENT OF ESTABLISHED DEFORMITY

For cases in which the dislocation was established, we formerly advised operative removal of the radial head (Cases 25, 26 and 27). The post-operative increase in supination of the forearm and extension of the elbow was disappointing. After completion of the investigation described in this paper the operation was altered to include an osteotomy through the upper third of the ulna, thus allowing reposition of the radial axis. Two cases have so far been operated upon and the results are encouraging.

ANTERIOR DISLOCATION

There remain the cases of anterior dislocation (see Figs. 35 to 37). It will be noted that this dislocation is present at birth and that the anatomical features (as shown radiographically) at the age of several years are identical with those described by McFarland as occurring in what he calls congenital dislocation. In his patients there was neither paralysis nor history of injury. He is quite aware (personal communication) that in some of his cases the dislocation might have been due to injury at a very early age, but some are undoubtedly congenital. He has told me of a bilateral dislocation and I print radiographs of this patient for comparison with my own anterior dislocations associated with Erb's paralysis (Fig. 38).

SUMMARY

1. In a survey of 107 cases of Erb's paralysis, twenty-seven instances of incipient or actual posterior dislocation of the upper end of the radius were discovered.
2. The type of case in which the dislocation occurs is defined and the early clinical and radiographic signs of the displacement are described and illustrated.
3. The probable causes—muscle imbalance and rigid splinting over a long period—are adumbrated and the prevention and remedies are suggested.
4. The occurrence of anterior dislocation—six cases—and its significance are discussed.

I am deeply indebted to Mr A. P. Laird for his interest and valuable advice during this investigation, which was undertaken at his suggestion after his finding of the first case, and which includes cases treated in his Unit. I also wish to thank Mr Matthew White for his permission to make use of cases of Erb's paralysis treated in his Unit. I am grateful to Professor B. L. McFarland for his interest and most valuable assistance in preparing this paper, and for the use of Figure 38. I am indebted to Mr J. Patrick and the Journal of Bone and Joint Surgery for their permission to reproduce Figure 32.

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HALLUX VALGUS AND HALLUX RIGIDUS

A Critical Survey of Operative Results

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For this study an unselected group of patients was examined who underwent operative treatment for hallux valgus and hallux rigidus at the Royal National Orthopaedic Hospital between the years 1920 and 1950 (Table I). In it, an attempt has been made to apply to clinical observations a mode of assessment based on criteria rigid enough to exclude personal prejudice.

THE METHOD OF STUDY

The examination of the cases involved the extraction from the patient and from the clinical notes of details of the pre-operative condition, operative methods, post-operative treatment and course, and eventual result. On account of defects both in patients' memories and clinical notes, the assessment of the first three factors was not as accurate as could have been wished, and accordingly a separate study of a current series of cases was later made with the object of comparing pre- and post-operative states and assessing the value of different methods of post-operative treatment.

TABLE I

MATERIAL STUDIED

Patients examined and operations reviewed (hallux valgus and hallux rigidus) with sex incidence

Total patients 325		Total operations 518
HALLUX VALGUS		
Patients	281	(Over 90 per cent women)
Operations	461	
HALLUX RIGIDUS		
Patients	44	(Females 30; Males 14)
Operations	57	

Because (as noted by Perkins 1927) the patient's view of the functional result frequently differs widely from that of the surgeon, two sets of functional criteria—objective and subjective—were laid down. Moreover, as the appearance of the foot bore no constant relation to either of the foregoing, separate criteria of anatomical results were adopted. These three categories and their grading are set out in Table II. In hallux rigidus the functional criteria only were applied, since anatomical abnormality alone is not commonly the presenting symptom of this condition.

It should be recognised that a similar objective functional result may be associated with an entirely different subjective functional result in different cases. Thus, in the presence of a good range of passive movement, lack of the power of active flexion of the great toe may be insignificant in one engaged in a sedentary occupation, but a cause of major disability to an

TABLE II

ANATOMICAL AND FUNCTIONAL GRADING

I. ANATOMICAL GRADES				
Grade				
4	Hallux valgus	less than 20 degrees.	No bunion.	
3	Hallux valgus	20 to 30 degrees.	Bunion.	
2	Hallux valgus	30 to 50 degrees.	Bunion.	Bursitis.
1	Hallux valgus	over 50 degrees.	Bunion.	Bursitis.
II. SUBJECTIVE FUNCTIONAL GRADES				
Grade				
4	No symptoms; no restriction of normal activity.			
3	Symptoms occasional, causing no restriction of normal activity.			
2	Symptoms constant, causing intermittent limitation of normal activity.			
1	Symptoms constant, causing total limitation of normal activity.			
III. OBJECTIVE FUNCTIONAL RESULT (Regarding function of first metatarso-phalangeal joint)				
Grade				
4	Dorsiflexion 30 degrees or more; active plantar flexion 15 degrees or more.			
3	Marked limitation of either dorsiflexion or plantar flexion.			
2	Marked limitation of both dorsiflexion and plantar flexion.			
1	No movement possible.			

TABLE III

RADIOGRAPHIC FEATURES EXAMINED

HALLUX VALGUS
Degree of metatarsus primus varus (angle between long axes of shafts of first and second metatarsals).
Degree of hallux valgus.
Relative lengths of first and second metatarsals.
Amount of subluxation of first metatarso-phalangeal joint.
Evidence of degenerative change in the first metatarso-phalangeal joint or other foot joints.
Presence or absence of a growing epiphysis of the first metatarsal.
Degree of valgus at second metatarso-phalangeal joint.
Post-operative features:
Amount of bone removed and evidence of bone regeneration.
Residual bone fragments and irregularities of cut surfaces.
Width of "false joint."
Site of osteotomy.
Other features including march fracture, Freiberg's infraction, rotation of first phalanx.
HALLUX RIGIDUS
Relative lengths of first and second metatarsals.
Degree of degenerative joint changes.
Evidence of metatarsus primus elevatus.
Post-operative and other features as in hallux valgus.

athlete. Again an almost completely stiff first metatarso-phalangeal joint may not be noticed by the patient as long as the interphalangeal joint retains good mobility. Even complete ankylosis of the metatarso-phalangeal joint may constitute no disability if it is completely fixed and painless and if the great toe is in a good position.

Each patient with hallux valgus was radiographed according to a standard technique of a single antero-posterior view of the weight-bearing forefoot, additional views being taken only when thought necessary. In each case of hallux rigidus an additional true lateral view in weight-bearing was taken. Table III summarises the features examined in these radiographs.

Using these methods of investigation we have been able to formulate certain views on the etiology of these conditions, as well as on their response to treatment.

FIG. 1

A typical example of women's footwear superimposed on the foot to show the relations of size and shape between the foot and the shoe.

HALLUX VALGUS

ETIOLOGICAL ASPECTS

Sex incidence—There is a very marked female preponderance. While this preponderance is clearly not fictitious, it is probably factitious, since men are more ready than women to wear shoes suitable to the shape of their feet (Fig. 1). Similar conclusions are drawn by Cleveland and Winant (1950).

Metatarsus primus varus—Figure 2 shows that in this series most of the affected feet had intermetatarsal angles of from 11 to 20 degrees (*cf.* Hardy and Clapham 1951).

Hereditary influences—Figure 3 shows the increased frequency of an early onset of symptoms in the group giving a family history of hallux valgus.

OPERATIVE METHODS AND RESULTS

Broadly speaking, operative methods in hallux valgus fall into two main groups: those directed at the effects of the condition and those directed at its cause. In the first group are

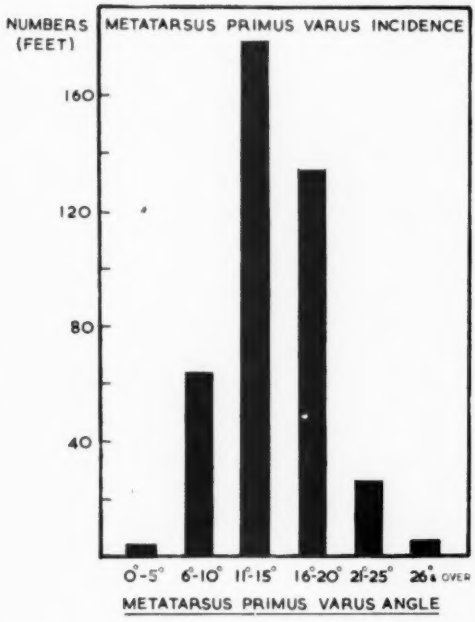

FIG. 2

Degree of metatarsus primus varus in 461 cases of hallux valgus submitted to operation.

the operations of simple excision of the "exostosis"; arthroplasty by the technique of Keller (1904)—originally practised for hallux rigidus and flexus by Davies-Colley in 1887—or of Mayo (1908) with its subsequent modifications, or of Porter (1909); and arthrodesis either by the technique of Girdlestone and Spooner (1937) or of Brockman.

In the second group are operations on bone designed to correct metatarsus primus varus (Rocyn Jones 1948), operations on bone and soft tissue designed to correct also the deviation of the great toe (Lapidus 1934), and operations chiefly on soft tissue designed to correct either metatarsus primus varus, hallux valgus or both (Fowler 1907, McBride 1935, Joplin 1950).

The multiplicity of techniques gives an indication of their probable shortcomings and of the difficulty in the assessment of results. It was, for instance, dissatisfaction with the results of the Keller operation (Rogers and Joplin 1947) that led Joplin to the elaboration of the "sling" operation mentioned above. In this respect the results found by Rogers and Joplin should be compared with those obtained by Cleveland and Winant (1950).

HALLUX VALGUS IN THE ADOLESCENT

The frequency of an early age of onset and the predominance of a high degree of metatarsus primus varus suggests that it may be correct to intervene in adolescence with an operation of the second group directed at the primary deformity. The results of Keller operations performed in the presence of a growing epiphysis have been uniformly bad. Our main survey of treatment in the adolescent has been directed to the effects of the operations of primary correction, and we have included as "adolescents" those aged from ten to seventeen years inclusive. The operations performed have been variants of the basic type of metatarsal osteotomy (Table IV),

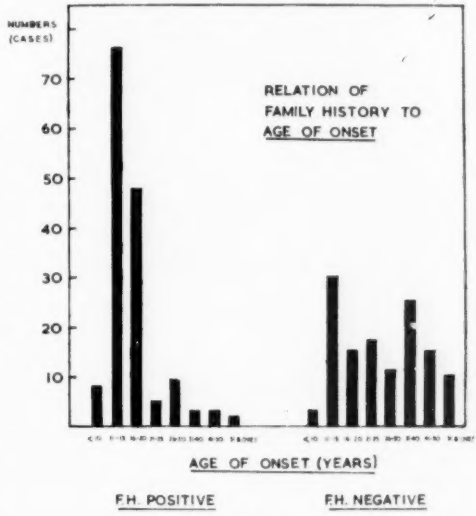

FIG. 3

Age of onset in familial and non-familial types of hallux valgus.

and the results (Fig. 4) are distinctly poor. Of the fifty-four feet operated upon no less than twelve were found at the time of review to require or to have had further operative treatment.

We were led, therefore, into a more detailed analysis of the causes of failure. The aim of the operation being to reduce permanently the angle between the first and second metatarsals, it is pertinent to inquire whether the operation commonly succeeds in this aim

TABLE IV

METATARSAL OSTEOTOMY IN ADOLESCENTS
(Age 10 to 17 years)

Number of patients	.	34
10 to 13 years	.	10 patients
14 to 17 years	.	24 patients
Number of operations	.	54
Length of follow-up:		
Under 1 year	.	11 patients
1 to 5 years	.	17 patients
More than 6 years		6 patients

and, if it does succeed, whether the eventual result is good. In thirty-four of the fifty-four feet operated upon the metatarsus primus varus returned to its original state or to a larger angle than before operation after intervals varying between one day and three months after operation. In those cases in which permanent correction was achieved the results were better than those of the whole group (Fig. 5). It is thus necessary to inquire into the reasons for failure to obtain permanent correction. We believe that this may be due either to failure to achieve primary correction or to inability to maintain a well-executed primary correction.

Primary failure may result from: 1) simple technical failure to swing the first metatarsal towards the second; 2) obtaining a "false" correction by soft-tissue compression with

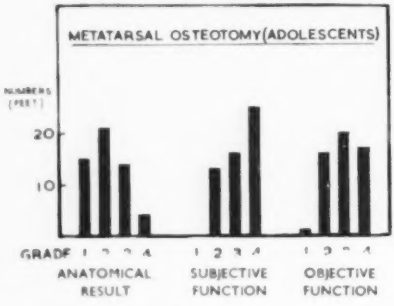

FIG. 4

Results in the whole group of fifty-four adolescent cases of hallux valgus treated by metatarsal osteotomy.

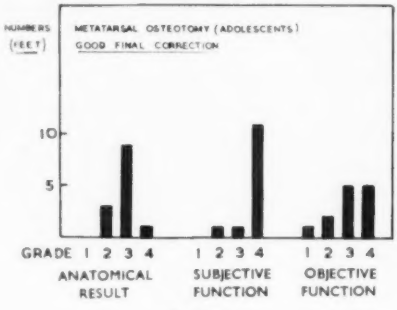

FIG. 5

Results of metatarsal osteotomy in twenty adolescent cases of hallux valgus in which good correction was secured and maintained.

subsequent springing out of the first metatarsal on removal of the plaster; or 3) producing "correction" by swinging the proximal end of the cut first metatarsal medialwards on an axis passing through the first metatarsal head instead of swinging the head laterally towards the second metatarsal on an axis passing through the line of bone section. Figure 6 shows the comma-shaped first metatarsal produced by the former process.

FIG. 6

Metatarsal osteotomy for hallux valgus. Post-operative radiograph showing false correction by the production of a comma-shaped first metatarsal.

FIG. 7

FIG. 8

FIG. 9

Metatarsal osteotomy in a patient with a growing epiphysis. Figure 7—Pre-operative state. Figure 8—Immediately after operation, showing good correction. Figure 9—Six years later, showing return to a rather larger angle of metatarsus primus varus.

Failure of maintenance may result from: 1) too early weight-bearing (before the bone ends have united); 2) inadequate immobilisation during this critical period; or 3) section of the first metatarsal distal to a growing epiphysis, further bone growth occurring in a varus direction with consequent early recurrence of deformity. There is some evidence in support of this last point: of fourteen feet in which it could be established that a good primary correction had been obtained by section distal to a growing epiphysis, no less than ten relapsed (Figs. 7 to 9), whereas of twenty feet in which good correction was obtained after epiphysial closure only nine relapsed subsequently.

Quite apart from failure of correction, the osteotomy operation may fail for any of the following reasons. 1) The operative production of an elevated or depressed first metatarsal segment (Fig. 10). 2) Long continued post-operative stiffness of the first metatarso-phalangeal

FIG. 10

The operative production of a metatarsus primus elevatus. The first metatarsal has been outlined to show the point clearly.

joint. 3) Careless trimming of an exostosis with a consequent increase of the hallux valgus. 4) Failure to obtain correction of the hallux valgus on account of unrelieved soft-tissue contraction. 5) Over-correction of the metatarsus primus varus combined with trimming of an exostosis may lead to actual medial subluxation at the first metatarso-phalangeal joint.

In spite of all these difficulties it does appear to be logical to attack the primary deforming factor, the metatarsus primus varus, from the standpoint both of etiology and functional results. This probably applies to the female adolescent only, because in the male the condition is not likely to cause persistent symptoms in adult life. After the epiphysis has closed this aim can be achieved by osteotomy of the first metatarsal provided that true correction is obtained and maintained until bony union has occurred. In order to do this an operation has been devised in which a greenstick osteotomy of the metatarsal is performed and correction maintained by a combination of the following procedures: 1) using the excised capital exostosis as a block to keep the osteotomy site wedged open; 2) clearing the first inter-metatarsal space and, if necessary, dividing the fibular side of the capsule of the first metatarso-phalangeal joint; and 3) visually approximating the heads of the first two metatarsals by means of a transverse screw, in such a way as to preserve their normal relationship as parts of a low arch. This screw is removed when bony union has occurred (Figs. 11 to 13). Post-operative immobilisation is maintained by a crêpe bandage for the first two weeks and by a below-knee plaster for a further four. As this operation is as yet only in a formative stage and as its full difficulties and complications have not yet been worked out nor its ultimate results assessed, only one comment can be made on it at the present time. This is that, when properly done, and for the correct indication, it is capable of producing a permanent correction of metatarsus primus varus and a good functional and anatomical result.

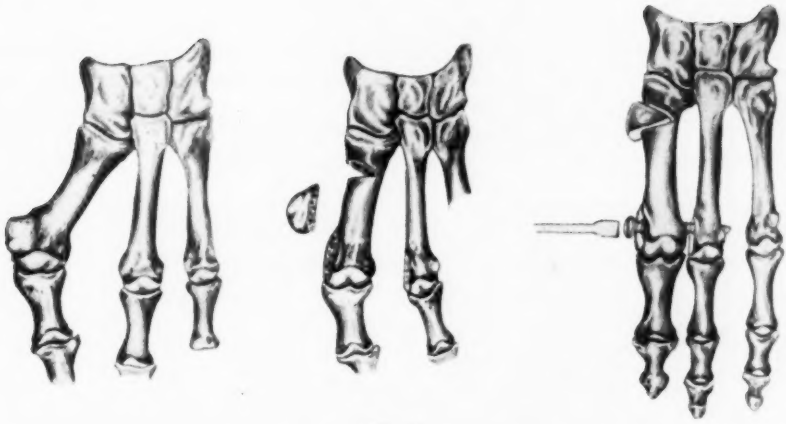

FIG. 11

Operation for permanent correction of metatarsus primus varus. It has been found that the trimming of the medial side of the second metatarsal head, shown in the drawing, is not essential for the success of the operation.

FIG. 12 FIG. 13

Operation for reduction of metatarsus primus varus angle. Figure 12—Pre-operative state. Figure 13—After removal of plaster, showing good correction. Note considerable reduction in degree of abduction of fifth metatarsal after operation and subsequent confinement in plaster.

When the epiphysis is still open metatarsal osteotomy is inadmissible. It may be possible, as was done with success in one case (Figs. 14 and 15), to correct the metatarsus primus varus by an osteotomy passing through the medial cuneiform bone. This procedure is rather similar to that of Young (1910) but does not entail any interference with the first tarso-metatarsal joint. The possibilities of stapling the lateral side of the first metatarsal epiphysis are attractive, but technical difficulties and problems of foot growth will need attention before this is to be undertaken as a routine procedure.

FIG. 14 FIG. 15

Operation for correction of metatarsus primus varus by osteotomy proximal to the first metatarsal. Figure 14—Pre-operative state. Figure 15—One year after corrective osteotomy through the medial cuneiform. Relief of symptoms was complete. (Excision of exostosis had been carried out previously without relief.)

HALLUX VALGUS IN THE ADULT

Metatarsal osteotomy—We have been able to study the results of thirty-nine metatarsal osteotomies in twenty-six patients aged eighteen years or more (Table V). The anatomical and functional results have not been good (Fig. 16). Since arthroplasty carries with it a

TABLE V

METATARSAL OSTEOTOMY IN ADULTS
(18 years and over)

Number of patients	.	26
Number of operations	.	39
Length of follow-up:		
Under 1 year	.	5 patients
1 to 5 years	.	18 patients
More than 6 years		3 patients

reasonable prospect of a good result, to substitute for it an operation requiring a long period of immobilisation and probably long continued physiotherapy certainly requires justification. This justification might be claimed for three reasons: 1) metatarsal osteotomy corrects the primary deformity, leaving the first metatarso-phalangeal joint untouched and possessed of its normal function; 2) the operation makes the foot narrower and able to be fitted into a

"shop" shoe; and 3) the results of osteotomy are significantly better than those of arthroplasty. In our series these claims have not been substantiated. The mobility remaining in the first metatarso-phalangeal joint was certainly no better and was probably worse than that obtained by arthroplasty. Secondly, of the twenty-six adult osteotomy cases six were found to require either the fitting of surgical shoes or further operation to allow them to wear ordinary shoes.

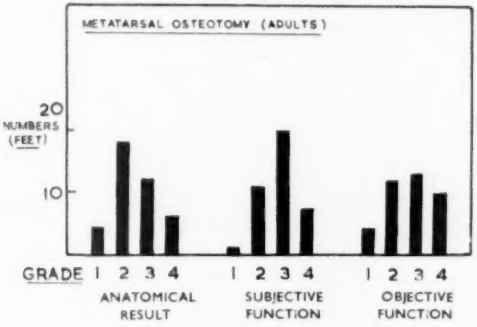

FIG. 16

Results in thirty-nine cases of hallux valgus treated by metatarsal osteotomy.

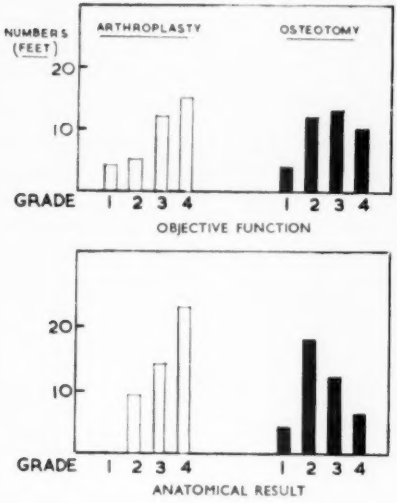

FIG. 17

Results of metatarsal osteotomy in adults compared with those of arthroplasty in a similar age group.

FIG. 18

Metatarsal osteotomy in an adult. Correction was maintained and there were no symptoms five years after operation.

Thirdly, the anatomical and functional results were no better than those obtained by arthroplasty in a comparable series (Fig. 17).

There appear to be two main causes for the poor results obtained. First, in its application to most cases of adult hallux valgus the operation is wrongly conceived. It involves placing the articular surface of the first phalanx in relation to an area of the metatarsal head which through long continued subluxation is usually denuded of cartilage. Moreover there is

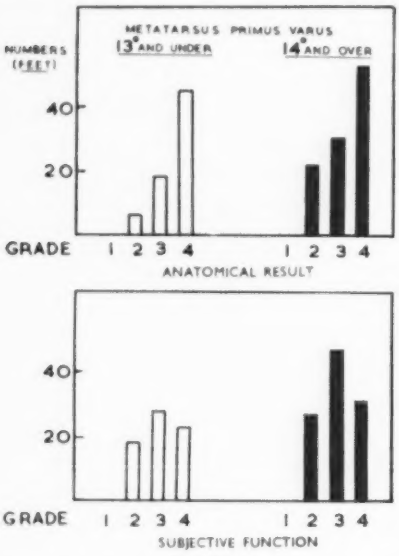

FIG. 19

Results of arthroplasty in a group with a large metatarsus primus varus angle compared with those of a group with a small angle.

no attempt to overcome the soft-tissue contraction associated with the hallux valgus. The aim of the operation is the late correction of a long standing deformity to which the foot has, in the course of years, adjusted itself.

The second main cause of indifferent results is failure to maintain correction of the metatarsus primus varus. In thirty-nine operations there was evidence of final correction in only twenty-one.

It would not, however, be fair to leave this subject without stating that occasionally the results obtained are excellent (Fig. 18). In this series of twenty-six patients there were two whose occupations made severe demands on their feet—one a professional dancer, the other a physical training instructor. Both were able to return to their original work after operation, and it is doubtful whether arthroplasty would have left them equally active.

It seems that metatarsal osteotomy in the adult requires a more careful selection of cases than has hitherto been appreciated. The patients should be reasonably young and should present a large angle of metatarsus primus varus with a normal first metatarsophalangeal joint. Even so, a meticulous technique of operation is essential for success in this procedure, and only under these conditions is an extended trial of the operation justifiable.

Combined osteotomy and arthroplasty—Too few results of such operations have been seen to permit criticism on the basis of experience. However, if the operation is to have a rational basis in theory it should be possible to show that the results of arthroplasty are significantly better in feet with a low than with a high metatarsus primus varus angle. This, in fact, has not been shown (Fig. 19).

TABLE VI

ARTHROPLASTY FOR HALLUX VALGUS

Total patients 160	Total operations 266
Keller's operation .	Patients 113; Operations 188
Mayo's operation . .	Patients 48; Operations 78

Length of follow-up	Cases
Under 1 year	73
1 to 5 years	30
6 to 10 years	30
Over 11 years	27

The results of arthroplasty—In this series most of the arthroplasties studied have been of the Keller or modified Mayo type (Table VI). The total results (Fig. 20) are moderately

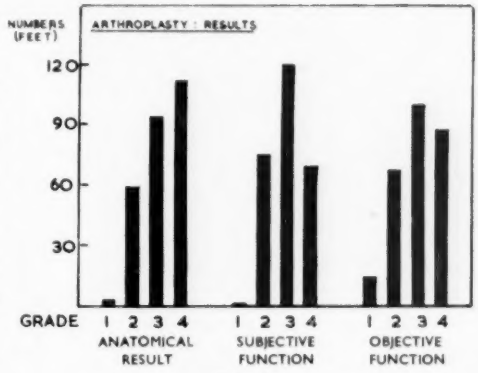

FIG. 20

Results of arthroplasty in whole series (266 operations).

good but by no means as good as those obtained by Cleveland and Winant (1950). There may also be some deterioration in the functional result during the course of years after the operation (Fig. 21). The causes of this partial failure may be grouped under three headings: 1) *Pre-operative factors*—The age of the patient at operation determines to some extent the eventual result (Fig. 22), the proportion of first-class results becoming smaller in the oldest age group. *The type of hallux valgus:* Figure 23 shows the results in the three types of hallux valgus recognised in this series: (the adolescent type, in which painful symptoms occur in adult life as an extension of deformity and occasional pain starting in childhood; the adult type, in which pain and deformity first appear in adult life; and the arthritic type in which pain and deformity are a part of local or generalised degenerative joint changes). The results in the third group were worse than those in the first two. *Occupation:* The majority of the patients studied here were housewives, and were able to modify their activity to some extent when foot pain became extreme. In such patients operation usually produced increased activity, and in those engaged in sedentary occupations the results were even better. In the case of patients whose work involved long-continued strain on the feet operation more commonly than not necessitated the adoption of less active work. In this respect our impressions are similar to those of Rogers and Joplin (1947) and differ from those of Perkins (1927).

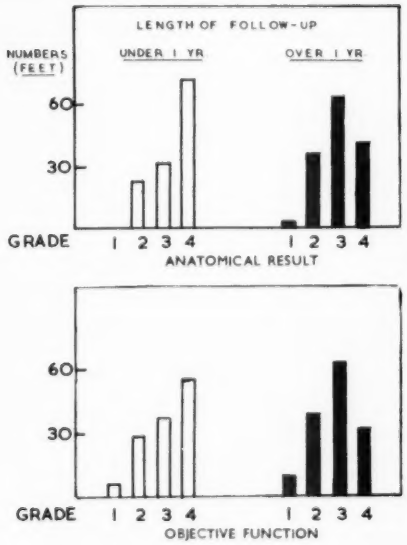

FIG. 21

Arthroplasty: results assessed within one year of operation compared with those observed for more than one year.

Marked *valgus deformity of the second toe* is a contra-indication to operation only when it cannot be corrected passively. In twelve cases in which the average pre-operative deviation of the second toe, as measured on the radiograph, was 20 degrees the average post-operative deviation was 7 degrees only. In one case the re-alignment was as great as 20 degrees and in the only case in which correction of valgus of the second toe was not obtained the deformity could not be passively corrected before operation.

In the *very broad foot* the correction of hallux valgus alone does not allow the patient to wear ordinary shoes. In such a case it is probably wiser and more economical to avoid operation and to provide surgical shoes.

Metatarsalgia has been one of the most common associated foot conditions encountered, being present pre-operatively in 45 per cent of the cases of this section of the series. If haliux

valgus is considered to be simply one facet of a general foot dysfunction it is desirable that an operation for its relief should benefit other features of the disorder. It does not appear (Fig. 24) that arthroplasty has any constant or predictable effect on pre-existing metatarsalgia or in producing it as a new feature. Nor does it appear that Mayo's operation is more likely

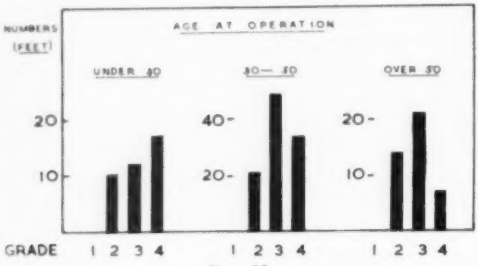

FIG. 22

Arthroplasty: objective results according to age at the time of operation.

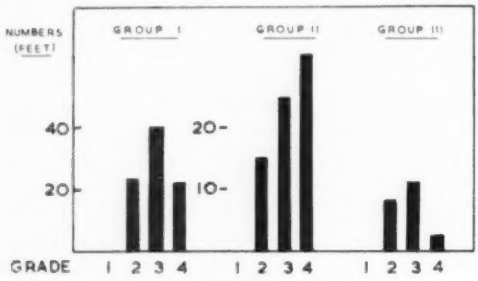

FIG. 23

Arthroplasty: subjective results in adolescent type (Group I), adult type (Group II) and arthritic type (Group III).

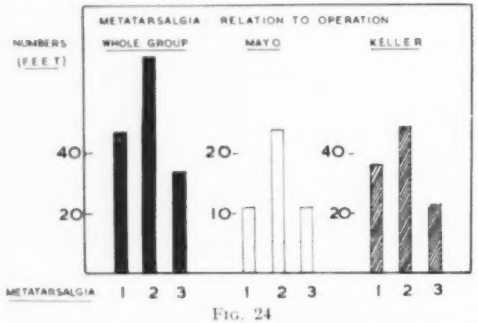

FIG. 24

Effect of arthroplasty on metatarsalgia (whole group, Mayo group, Keller group). 1 = Metatarsalgia relieved; 2 = metatarsalgia unaltered; 3 = metatarsalgia produced or made worse.

than Keller's to produce or aggravate metatarsal pain (Fig. 20). A study of metatarsus primus varus angles fails to link a large angle with the aggravation or otherwise of metatarsalgia, and examination of such other factors as post-operative function of the first metatarso-phalangeal joint throws no light upon the problem. Our findings thus do not support the views of Perkins

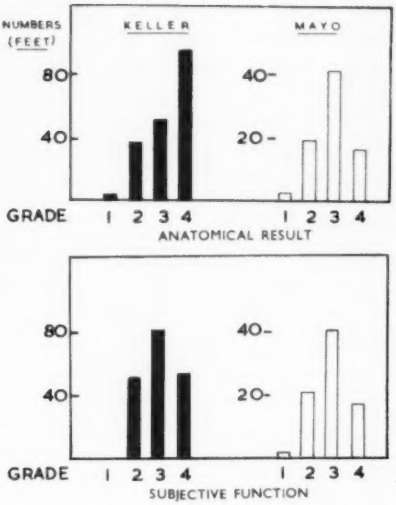

FIG. 25

Comparison of results of Keller and modified Mayo operations for hallux valgus.

FIG. 26

Mayo's operation. Too little bone removed. The metatarso-phalangeal joint was stiff and pain persisted.

(1927) or of Lloyd (1936) as to the cause of operative aggravation or production of metatarsalgia. Clearly a closer study of the causation of metatarsal pain is necessary for this point to be resolved. As regards practical policy it is obviously necessary to be quite certain before deciding on operation that true bunion or joint pain rather than metatarsalgia is the predominant symptom.

2) *Operative factors—The type of operation:* Although Lloyd (1936) reported equally good subjective functional results with Keller's and Mayo's operations this view is not shared by all orthopaedic surgeons. In this series analysis of functional and anatomical results (Fig. 25) shows that there is nothing to choose between the results of these two operations.

The technique of operation: In the Keller operation a certain optimal point is reached between the advantage of a large bone removal in the production of a wide arthroplasty and its disadvantage in the production of a short great toe possessed of no active movement. This optimal point seems to be reached on the removal of between one third and one half of the proximal phalanx. Bone regeneration to the extent seen by Cleveland and Winant (1950) in one case has not been observed in this series, though in several cases radiographic evidence of regeneration clearly indicated that the removal had been subperiosteal. Rather less latitude is allowed in the removal of the metatarsal head in Mayo's operation, too small an excision resulting in a stiff joint (Fig. 26), while too great an excision leads to excessive transference of weight to the second metatarsal head. It is this rather critical level of bone removal which may account for the bad results of Mayo's operation in less experienced hands and the consequent disfavour into which this operation has fallen.

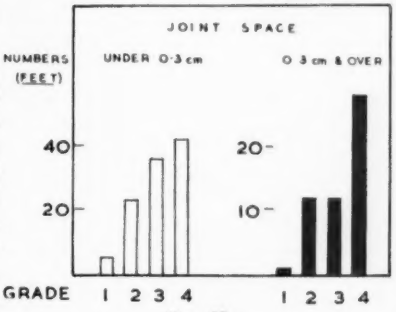

FIG. 27

Relation of width of pseudarthrosis to objective functional result.

Since a good " joint space " is usually linked to a good functional result (Fig. 27) it may be asked whether this may be ensured by continuous post-operative traction on the phalanx. Figures 28 and 29 show that though the initial joint space may be large there is no certainty that it will remain so, and attempts to maintain a wide space in the first two post-operative weeks thus appear to be misdirected. The phenomenon of spontaneous regression of joint space may account for the falling off in results with increase in length of the follow-up period.

FIG. 28 FIG. 29

Showing spontaneous reduction in width of pseudarthrosis after Keller's operation. Figure 28—Radiographs taken soon after operation showing wide space. Figure 29—Four months later: considerable reduction in width of space.

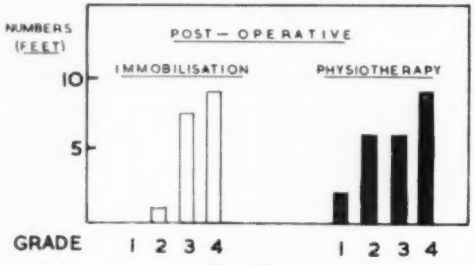

FIG. 30

Arthroplasty: objective functional results according to type of post-operative treatment.

Fragments of bone left behind appear to have little influence on the results, provided this untidiness is not carried too far. Spurs left on the medial aspect of the metatarsal neck after trimming of osteophytes in a Keller's operation are productive of symptoms only in a thin foot.
3) *Post-operative treatment*—In order to assess the relative merits of early mobilisation and of immobilisation as post-operative treatment a current series was studied of cases operated on by the same three surgeons each using the Keller technique. In one group mobilisation of the arthroplasty was started twenty-four hours after operation; in the other, plaster incorporating the first metatarso-phalangeal joint was applied post-operatively and retained for two weeks. There was nothing to choose between the objective functional results in these two groups (Fig. 30); this suggests that mobility of the new joint does not depend upon what is termed " early mobilisation."

TABLE VII

EXCISION OF EXOSTOSIS FOR HALLUX VALGUS

Total patients 68	Total operations 97
Length of follow-up	Cases
Under 1 year	5
1 to 5 years	39
6 to 10 years	13
Over 11 years	11

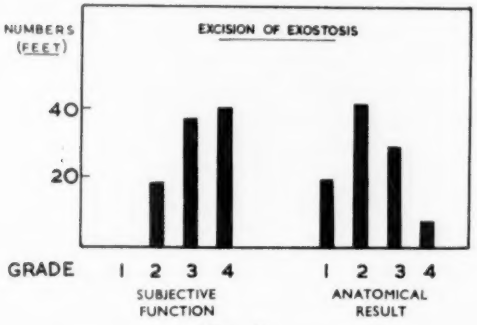

FIG. 31

Results of excision of exostosis for hallux valgus.

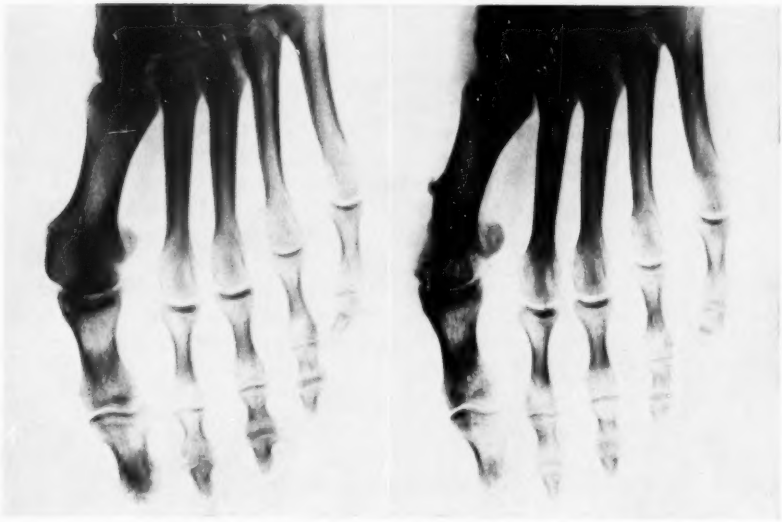

FIG. 32 FIG. 33

Showing increase in hallux valgus after excision of exostosis. Figure 32—Before operation. Figure 33—Five months after operation.

The results of excision of the exostosis alone—In this group sixty-eight patients were seen who had undergone excision of the exostosis alone. In twenty-nine the operation was bilateral, so the total number of toes operated upon was ninety-seven (Table VII). As might be expected, the anatomical results were poor, but the subjective functional results good (Fig. 31). However, of the sixty-eight patients twenty-five were found to require further conservative or operative treatment. This suggests that the apparently good functional results are possible only by additional treatment. It may be, too, that the poor anatomical results are partly determined by interference with the distal end of the abductor hallucis, causing an increase of the hallux valgus. This possibility is illustrated in Figures 32 and 33. It appears from this study that trimming of the exostosis alone is justified only in the following types of case. 1) When the bunion itself is the sole cause of symptoms and the fixation of the first metatarso-phalangeal joint prevents further deviation of the great toe. 2) When general

TABLE VIII

OPERATIONS FOR HALLUX RIGIDUS

Total patients .	44
Total operations .	57
Arthroplasty . .	48
Excision of exostosis	9
Length of follow-up	**Cases**
Under 1 year	25
1 to 5 years	11
6 to 10 years	2
Over 11 years	6
Age at operation	**Patients**
10 to 20 years	2
21 to 30 years	6
31 to 40 years	8
41 to 50 years	15
Over 51 years	13

conditions (such as polyarthritis) or local conditions (such as an amputated second toe) contra-indicate arthroplasty, and removal of a large exostosis is necessary for the fitting of surgical shoes. 3) When the exostosis is the sole cause of symptoms and a cosmetically good result is not required.

HALLUX RIGIDUS

Forty-four cases were seen in which fifty-seven operations had been performed (Table VIII).

ETIOLOGICAL ASPECTS

Sex and age—There was a 2 : 1 preponderance of females over males. The larger proportion of men compared to that in the hallux valgus series does not wholly reflect the true sex incidence but rather the different mentalities of the male and the female. The man does not

commonly seek operation for cosmetic reasons and when a bunion is painful he is sensible enough to wear larger shoes. He is, however, brought to seek relief from the persistent pain and restriction of activity caused by the joint changes and dorsal exostosis of a hallux rigidus.

A positive family history predisposed to an earlier onset of symptoms; 50 per cent of patients with an onset of symptoms before the age of twenty had a positive family history, whereas only 10 per cent of the patients whose symptoms came on after that age knew of a similar condition in their relatives.

Six patients gave a definite history of injury preceding the onset of symptoms, and in six others the toe condition was associated with generalised arthritis.

Metatarsus primus elevatus—Jack (1940), studying the etiology of hallux rigidus, found "hyperextension" of the first metatarsal segment to be clinically demonstrable in fourteen of twenty-two affected feet and he related the degenerative changes in the first metatarso-phalangeal joint to this abnormality. In our series a similar proportion (two-thirds) of the affected feet showed a metatarsus primus elevatus, but this deformity appeared to be in the nature of a fixed deformity rather than of a hypermobility as postulated by Jack in his development of Morton's views. The question of whether the hyperextension of the first metatarsal causes the first metatarso-phalangeal joint changes or vice versa is still unanswered. It is certain that metatarsus primus elevatus is often demonstrable well before the degenerative joint changes are appreciable (Lambrinudi 1938), and in one of our cases the operative production of a metatarsus primus elevatus was followed by the development of a hallux rigidus. Furthermore, it was Lambrinudi's view that correction, in the adolescent, of a metatarsus primus elevatus was followed by a regression of the changes in the first metatarso-phalangeal joint. The weight of evidence appears to favour the first metatarsal extension as being the primary condition, but it must be added that cases are seen in which the development of a metatarsus primus elevatus appears to follow the operative production of a stiff and painful first metatarso-phalangeal joint. Whatever may be its role in etiology metatarsus primus elevatus is clearly of bad significance in the prognosis of operating for hallux rigidus.

Relative length of first and second metatarsals—Nilsonne (1930) found that most of his patients with hallux rigidus had a first metatarsal longer than the second. Comparing the relative lengths of the first and second metatarsals in hallux rigidus with those obtaining in cases of hallux valgus with small metatarsus primus varus angles, we found that in twenty-two of fifty-three feet of the former group the first metatarsal was 0·5 centimetres or more longer than the second. In the latter group of thirty-three hallux valgus cases with a metatarsus primus varus angle of 10 degrees or less only six showed a similar relation of first and second metatarsal lengths.

OPERATIVE METHODS AND RESULTS

In the forty-three adult patients of this series the operation was by arthroplasty of Keller or Mayo type in forty-seven feet, and excision of the exostosis alone in nine.

The results of arthroplasty—Since improved appearance of the foot is not a primary object of the operation functional results only are considered. As indicated in Figure 34, the results are disappointing. These poor results have led us to an examination of the possible causes of failure. In some, the cause is clear: there may be a generalised arthritis of rheumatoid type as in three of the cases. In nine of the twenty-five cases showing metatarsus primus elevatus there was objective function

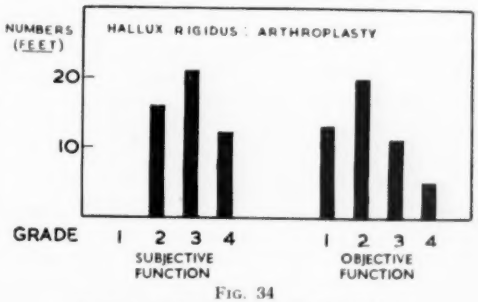

FIG. 34
Results of arthroplasty for hallux rigidus.

of grade 1 (*i.e.*, fibrous or bony ankylosis of the first metatarso-phalangeal joint), and these two causes thus account for a large proportion of the poor results.

Examining those patients with good subjective functional results we found that in each of these either passive dorsiflexion of the first metatarso-phalangeal joint was possible or the toe had fused in a dorsiflexed position. The converse is also true: the cause of failure is inability to regain dorsiflexion. Though it would thus appear possible to ensure success by removing bone widely to give a good dorsiflexion this may not be so in practice. Figure 35 shows a foot in which bone removal had been considerable, joint space was wide, and yet a poor functional result had been produced through inability to regain dorsiflexion. In the only adolescent patient (a girl of twelve years) subjected to arthroplasty the result was extremely bad, and this unhappy impression has been amply confirmed by similar cases seen subsequently outside the present series.

FIG. 35

Keller's arthroplasty for hallux rigidus. Despite adequate excision resulting in a wide pseudarthrosis there was almost complete lack of movement at the false joint.

The results of excision of the bony outgrowth alone—The results of smoothing of the bone are as poor as those of arthroplasty—an indication probably that the operation had not been confined to cases in which symptoms from the joint itself had ceased to be a feature.

DISCUSSION

We conclude that arthroplasty for hallux rigidus has no place in the treatment of the adult patient with metatarsus primus elevatus or generalised arthritis, nor of the adolescent case, and suggest the following plan of operative treatment in cases where adequate conservative treatment has failed to give relief.

1) *Adult case without elevated first metatarsal*—While arthroplasty has a fair chance of success in cases of this type the operation most certain of success is arthrodesis. It does, however, depend for a good result on the correct performance of a rather more difficult operation, on the patient's willingness to wear sensible shoes after operation, and on the presence of a good range of interphalangeal joint movement. Arthrodesis is most certain of success in men, and least appreciated by young women: in cases seen outside this series its results have been good.

2) *Adult case with elevated first metatarsal*—When arthrodesis, for any of the foregoing reasons, is inapplicable the combination of arthroplasty with osteotomy of the first metatarsal to correct elevatus is a rational procedure. Two such cases have been seen outside this series and have shown excellent results.

3) *Adult case with polyarthritis, or with symptoms referable solely to an exostosis*—Here excision of the exostosis is all that is required—in the former to permit the comfortable fitting of surgical shoes and in the latter to remove a painful encumbrance.

4) *Adolescent case not regressing spontaneously*—In such a case showing metatarsus primus elevatus the operation for depression of the first metatarsal introduced by Lambrinudi (1938) does, in some cases, restore joint function. Its success clearly depends on its performance before degenerative joint changes have occurred, because in the presence of irreversible joint changes the correction of the metatarsal deformity simply presses the great toe farther into the sole of the shoe. In such cases it may be possible to use the (usually good) range of plantar flexion through a functionally useful range by a greenstick extension osteotomy of the proximal phalanx.

Since this survey was made the future of arthroplasty in general has again been altered

by the experimental use of cortisone locally in such operations performed on dogs (Stinchfield 1950). What developments of this method may occur when cortisone becomes more easily obtainable and how these developments may affect arthroplasty of the first metatarso-phalangeal joint cannot be predicted. It is hoped, however, that the methods of critical examination outlined in this paper will find a useful application in evaluating the true worth of this new method.

SUMMARY AND CONCLUSIONS

1. A survey has been made of 518 operations for hallux valgus and hallux rigidus.

2. The methods of critical examination used in this survey are described.

3. The results obtained have led to the formulation of certain views on etiology and modes of treatment.

4. In hallux valgus in the adolescent, operations aimed at correcting the primary deformity are justifiable when correctly performed, though the exact form such operations should take still requires further study.

5. In hallux valgus in the adult, arthroplasty offers a reasonably good solution in the well chosen case, though no one should consider that the results are so good as to make unnecessary any further research in this field. Metatarsal osteotomy has in the adult only a limited sphere of application.

6. In hallux rigidus arthroplasty alone has no place in the treatment of the adult cases showing metatarsus primus elevatus, nor in the adolescent case. The possibilities of other methods of operative treatment, notably osteotomy, are discussed.

We wish to express our sincere thanks to the members of the staff of the Royal National Orthopaedic Hospital for allowing us to examine their patients, and to the Institute of Orthopaedics for providing the facilities. We would like to add special thanks to Mr A. Rocyn Jones and to Mr H. J. Seddon for their advice and help.

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CARPAL GANGLION AS A CAUSE OF PARALYSIS OF THE DEEP BRANCH OF THE ULNAR NERVE

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During the last forty years a few neurologists and surgeons have come to recognise various paralyses of the hand which develop spontaneously and seem to be local in origin. Various more or less plausible explanations have been offered but the only fairly constant etiological factor has been some sort of occupation which, if pursued for a sufficient length of time, somehow resulted in damage to the ulnar or median nerve. In this field of work the pioneer was J. Ramsay Hunt (1908, 1909, 1911, 1914).

The paralyses fall into three groups: those affecting 1) the median nerve in the palm; 2) the whole of the motor distribution of the ulnar nerve, excepting palmaris brevis, the branch of which runs with the sensory division of the nerve; and 3) the motor division of the ulnar distal to the branches supplying the hypothenar muscles.

This paper is concerned with the last group, the condition now usually referred to as traumatic neuritis of the deep palmar branch of the ulnar nerve, and its purpose is to show that this type of paralysis may be caused by a well localised and easily remediable mechanical compression. The cause of a similar affection of the median nerve was finally established by Woltman (1941) and Zachary (1945); the nerve is compressed by some means or other in the carpal tunnel. It was not unreasonable to suppose that some similar mechanism might explain traumatic neuritis of the deep branch of the ulnar nerve, and of the five cases that I have seen, four were due to compression of the nerve by a small ganglion emerging from the palmar aspect of a carpal joint. One case will be described in detail and the others are summarised in Table I, which includes all the published cases that I have been able to trace.

CASE REPORT

Case 16—Man aged fifty-eight years. Since 1948 he had been using a motor scythe which shook his hands quite violently; he was in the habit of swinging the machine to the left and, in consequence, the right hand suffered rather more trauma than the left. In May 1950 he began to notice a vague pain in the wrist. In June he felt acute pain on the ulnar side of the wrist which was quickly followed by weakness of the fingers, severe enough to prevent him from holding a razor. In October he noticed that the thumb sometimes felt cold though there was never any blanching; this disturbance of sensibility continued.

On examination (December 1950), there was complete paralysis of all muscles of ulnar innervation in the right hand, including flexor pollicis brevis but excluding the hypothenars and palmaris brevis; there was obvious wasting of all the interossei; there was no abnormality of sensibility.

Examination of the cervical spine, costo-clavicular region, other joints and other parts of the nervous system was entirely negative. Radiography showed nothing apart from an old injury of the base of the proximal phalanx of the little finger, which was clearly unconnected with the paralysis.

In view of the findings in three of the four earlier cases a diagnosis of compression of the nerve by a carpal ganglion was made with some confidence and exploration was accordingly undertaken.

Findings at operation (Fig. 1)—The ulnar nerve was traced to the hook of the hamate from which the short muscles were detached. Just opposite the hook and distal to the branches supplying the hypothenar muscles the nerve was found to be slightly swollen, and immediately beyond the swelling it was tightly stretched over a tense ganglion about one centimetre in diameter. The ganglion was removed and was seen to arise from the joint between the triquetral and hamate bones and had passed forwards between the fibres of the piso-hamate ligament. There was no response on stimulation of the nerve.

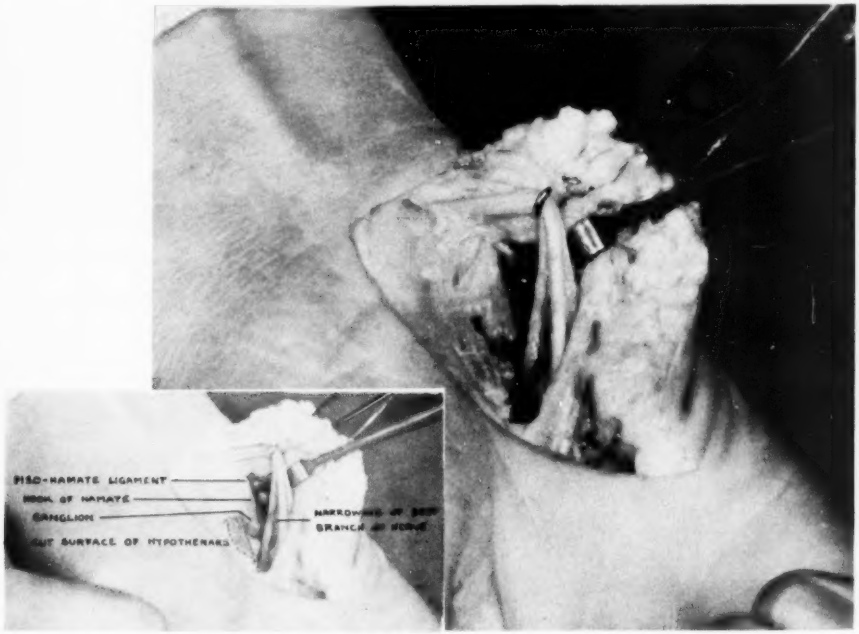

FIG. 1

Case 16—Photograph showing findings at operation with (inset) key to the structures shown.

The interossei were subsequently stimulated daily, with an electrical current of long duration, to prevent further wasting, and within six months of the operation all the affected muscles, except the second dorsal interosseous, were working well (power 4, Medical Research Council grading). Two months later power in the muscles was virtually full and the patient regarded his hand as normal. No explanation was ever found for the feeling of coldness in the thumb.

The findings in three other patients (see Table I, Cases 13, 14 and 15) were similar and their recovery was almost equally satisfactory.

DISCUSSION

The anatomy of the deep branch of the ulnar nerve has been described by all previous writers on the subject and there is no need to repeat it here. Neither is it necessary to review the literature in detail since an excellent digest was published in 1948 by Bakke and Wolff. It is important, however, to recall that the type of ulnar paralysis first described by Ramsay

TABLE I

SIXTEEN CASES OF PARALYSIS OF THE DEEP BRANCH OF THE ULNAR NERVE

Author	Case	Sex	Age	Occupation or injury	Side affected	Interval before onset of paralysis
Harris, W. 1929	1	M	—	Bootmaker: leather-cutting knife had produced callosities in palm	—	—
	2	M	—	Motor cyclist in habit of gripping controls too tightly with right hand	Right	—
Worster-Drought 1929	3	M	Young men	Motor cyclist	Right	Long period
	4	M		Motor cyclist	Right	Long period
	5	F	63	? Use of trowel	Right	Long period
	6	M	57	Doctor: addicted to cycling	Left	Long period
Russell, W. R. and Whitty, C. W. M. 1947	7	M	24	One rough motor cycle journey	Right	3 weeks or less
	8	M	32	Pushing in tent pegs with his hand—digging	Left	—
	9	M	61	Heavy gardening	Right	—
	10	M	33	Sheet steel worker	Left	? 2 weeks
(and Seddon)	11	M	48	Insurance agent Dupuytren's contracture	Right	—
Bakke, J. L., and Wolff, H. G. 1948	12	M	50	Telephone cable splicer, using wire-cutting shears hundreds of times a day	Right	31 years
Seddon, H. J.	13 (E. K.)	M	46	Heavy blow on ulnar border of hand; immediate sharp pain	Left	About 2 months
	14 (R.S.W.)	M	40	Explosion, blow on hand which, one month later, "felt curious"	Left	4 years
	15 (L. H.)	F	35	Fell on to outstretched hand hurting the ulnar side particularly. Five months later, pain in wrist when wringing clothes. Three days later weakness of hand noticed	Left	? 5 months ? 3 days
	16 (E. M.) see text	M	58	Used motor scythe, right hand being specially liable to injury	Right	2 years

Hunt must be considered separately, since in every one of his cases there was involvement of the hypothenar muscles. It appears that this more extensive paralysis has never been recorded in this country, and I myself have never seen an example of it.

Examination of the list of cases reveals the following significant points. 1) Most of the patients were male. 2) At least half of them were forty years old or more; the youngest in which the age was recorded was twenty-four. 3) In almost all there was a clear history of trauma, generally repeated; in a number of cases the occupation thought to be relevant had been pursued for years; in a few there was a single injury to the hand. 4) The onset of paralysis was either gradual or sudden. 5) In no case was there any demonstrable disturbance of cutaneous sensibility, though in two the patient gave a history of ulnar

TABLE I—*continued*

Type of onset	Pain, etc.	Paralysis	Duration of paralysis before examination	Treatment: findings at operation	Recovery
—	—	Complete	—	—	—
—	—	Complete	—	—	—
Rapid	—	Complete	—	—	—
Rapid	—	Complete	—	—	—
Rapid	—	Complete	—	—	—
Rapid	—	Complete	—	—	—
Fairly rapid	Paraesthesia in 4th and 5th digits at first	Weakness	3 months	Rest	Almost complete after 3 months
—	—	Weakness	1 month	Rest	Probable
Gradual	None—but painless swelling of hand	Weakness	2 months	Rest	Great improvement in 4 months
—	—	Weakness	6 weeks	Rest	Improvement after 7 weeks
Gradual	—	Complete	3 months	Exploration: nothing found	Complete in 14 months
Rapid	—	Complete	—	—	—
Gradual	Tenderness medial to hook of hamate	Complete	1 month	Ganglion excised	Complete in 7 months
Gradual	—	Complete	3 years	Ganglion excised	Still a little weak after 16 months
Fairly rapid	Pain and paraesthesia in 4th and 5th digits and local crepitus on pressure over pisiform	Weak (1: MRC) when first seen, less weak (3) 2 weeks later	5 months	Ganglion excised	Almost complete at 7 months
Rapid	—	Complete	7 months	Ganglion excised	Complete at 7 months

paraesthesia. 6) In one, swelling of the hand, site unspecified, had been noticed; in one of my cases there was tenderness medial to the hook of the hamate, and in another crepitus on pressure over the pisiform. 7) Accounts of the subsequent progress of the paralysis in the published cases are given only by Ritchie Russell and Whitty. In one it was almost complete in three months, in another complete in fourteen months; in two there was improvement in seven weeks and four months respectively; and in one case recovery probably occurred though the patient could not be followed up.

The question now is whether compression by a carpal ganglion is usually the cause of traumatic neuritis of the deep branch of the ulnar nerve, since such a lesion was found in four out of the five cases explored. It is not difficult to conceive that sudden or repeated trauma

might produce a rupture of some of the fibres of the triquetral-hamate joint which would allow the herniation of a small synovial sac. If the herniation occurred gradually the paralysis might be gradual in onset. A further sudden squeezing of a hernia already present might produce paralysis of quite rapid onset, as in the case that has been described in detail. On the other hand, there are cases in which the paralysis recovered spontaneously, and in one of them no ganglion was found on exploration. However, it is conceivable that this type of ganglion is capable of undergoing spontaneous shrinkage and ganglia encountered elsewhere not infrequently change in size. In Case 15 there was almost complete motor paralysis when the patient was first seen; two weeks later the muscles were much stronger; yet on exploration a ganglion was found, and it was not thought to be compressing the nerve, though it may well have done so at an earlier date. The ganglion in the case described in detail was examined by Dr H. A. Sissons and he found that it had precisely the same structure as ganglia arising in other parts of the body.

For the present, it is wiser to assume that ganglionic compression of the deep branch of the ulnar nerve is one cause of this type of traumatic neuritis, but not the only one. Yet as a matter of policy it would seem worth while to explore the nerve whenever this syndrome presents itself. The operation, although a delicate one, is not difficult, though the search for a ganglion in the region of the hook of the hamate is not as simple as it sounds. In one case the swelling was almost overlooked. Where a ganglion is found and removed recovery from the paralysis is very satisfactory; this alone is sufficient to justify exploration, because the data about the results of conservative treatment are still meagre and, from analogy with traumatic ulnar neuritis at the elbow, the sooner the compression is relieved the better the prospect of recovery.

CONCLUSIONS

Traumatic neuritis of the deep branch of the ulnar nerve may be caused by compression of the nerve by a ganglion originating in a carpal joint, and removal of the protrusion is followed by a prompt recovery. This lesion was found in four out of five explorations.

I am especially indebted to Mr R. G. Pulvertaft, who was kind enough to refer two of the patients (Cases 14 and 16) to me.

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NERVE COMPRESSION BY SIMPLE GANGLIA

A Review of Thirteen Collected Cases

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The precise etiology of the simple ganglion has always been a matter of some dispute. In most of the cases to be described a definite connection with the neighbouring joint or joint capsule was established at operation. On only one occasion did the histology of the excised ganglion resemble that of synovial membrane. However, it is generally accepted that if a synovial herniation becomes loculated as in a Baker's cyst, the lining membrane can undergo a metaplastic change to mesothelium. While the predisposing factors responsible for the formation of ganglia are by no means certain, accumulated evidence suggests that trauma to the joint may be important, and in cases of established osteoarthritis they are common.

Simple ganglia seldom give rise to serious symptoms and indeed their unsightly appearance in the neighbourhood of the wrist and hand is often the sole reason for seeking advice: in these circumstances the diagnosis and treatment are simple. The following collection of cases illustrates a less frequent manner in which they may present, namely by causing pressure on an adjacent nerve and producing a variety of neurological symptoms.

Since the ganglia were found to arise near joints, cases will be described in relation to the elbow and wrist in the upper limb and the knee and ankle in the lower limb. A series of cases of compression of the deep branch of the ulnar nerve in the hand by carpal ganglia is described elsewhere by Mr H. J. Seddon.*

CASE REPORTS

GANGLIA NEAR THE ELBOW

Case 1 (*Contributed by Mr O. J. Vaughan-Jackson*)—Man aged forty-eight years. Machine oiler. Complained of increasing numbness and tingling in the little finger of the right hand over a period of six weeks. He recalled no specific injury to the limb but had noticed that he had been unable to straighten the elbow fully.

On examination, there was an ill-defined, oval, elastic swelling about 5 centimetres in length within the flexor mass below the medial epicondyle of the humerus. Its lower pole was freely movable from side to side. Pressure on the swelling caused paraesthesiae in the little finger. The nerve felt rather thickened as it traversed the ulnar groove. *Neurological findings: Motor*—There was no wasting but definite weakness of the ulnar intrinisc muscles of the hand and a positive Froment sign. *Sensory*—Anaesthesia of the whole of the little finger and hypoaesthesia of the ring finger. *Radiographs* showed well-marked osteoarthritic changes in the joint (Fig. 1).

Operation—An oval cystic swelling, a simple ganglion, was discovered lying deep to the flexor mass, arising from the deep surface of flexor carpi ulnaris and attached by its upper pole to

FIG. 1
Case 1—Radiographs of the elbow showing osteoarthritic changes.

* See page 386 of this issue.

the medial surface of the olecranon and capsule (Fig. 2). The nerve lay in a narrow groove between the upper pole of the swelling and the medial surface of the olecranon and, after excision of the ganglion, was found to be markedly compressed and attenuated over a distance of 3 centimetres (Fig. 3). Proximal to the point of compression the nerve was oedematous and thickened. The ganglion was excised and anterior transposition of the nerve carried out. *Histology*—The histology of the cystic swelling was that of a simple ganglion.

FIG. 2

FIG. 3

Case 1. Figure 2—The ganglion exposed showing, just above it, the oedematous nerve lying in the groove behind the medial epicondyle (the position of the epicondyle is indicated by the artery forceps). Figure 3—The ulnar nerve has been mobilised from the groove behind the medial epicondyle. Note, just distal to this, the very narrow groove between the ganglion and the olecranon. Note also the marked narrowing of the nerve in the area of compression.

Progress—Three months after operation there was some objective evidence of sensory recovery but no change in voluntary power.

Case 2 (*Contributed by Mr R. G. Pulvertaft*)—Man aged twenty-eight years. Pork butcher. Complained of increasing flexion of the ring and little fingers of the left hand of one month's duration, associated with pain radiating from the elbow to these fingers. He himself had noticed a swelling on the inner side of the elbow for the same period.

On examination, there was a firm oval swelling, 1·5 × 0·5 centimetres, in the region of the medial epicondyle of the humerus. *Neurological findings : Motor*—Slight wasting and weakness of all muscles innervated by the ulnar nerve. *Sensory*—Hypoaesthesia in the ulnar cutaneous distribution. *Radiographs* showed no abnormality of the elbow or thoracic inlet.

Operation—A ganglion was found arising from the medial capsule of the joint at the point where the nerve emerged from the ulnar groove. The ganglion compressed the nerve on its postero-medial aspect against the joint. The ganglion was excised and the nerve was transposed.

Progress—There was immediate relief of pain, and a gradual improvement in voluntary power and sensibility was observed. Eight weeks after operation, no subjective or objective disturbance of sensory or motor function was detectable.

Case 3 (*Author's case*)—Man aged sixty-seven years. Labourer. Complained of pain on the inner side of the left elbow radiating to the ring and little fingers, associated with weakness of the hand and numbness of these fingers, for about four weeks. He had sustained a blow on the inner side of the elbow some two and a half years previously and since that time had been unable to extend the elbow fully. Within the last four weeks he had noticed a lump on the inner side of the elbow.

On examination, there was an oval swelling 3 × 4 centimetres situated below the medial epicondyle of the humerus, mobile in a transverse plane. Palpation of the swelling caused paraesthesiae in the ring and little fingers. There was some thickening of the nerve in the ulnar groove proximal to the swelling. *Neurological findings : Motor*—Marked wasting and weakness of all the ulnar-innervated muscles, intrinsic and extrinsic. *Sensory*—Anaesthesia of a classical ulnar distribution. *Radiographs* showed marked osteoarthritic changes in the elbow joint.

Operation—A ganglion was identified below the medial epicondyle, extending over the deep surface of flexor carpi ulnaris. It was traced proximally to the medial surface of the olecranon. No connection with the elbow joint was established. The nerve was compressed by the ganglion but was also thickened as it traversed the ulnar groove proximal to the ganglion. Anterior transposition of the nerve was performed after excision of the ganglion.

Progress—There was a rapid disappearance of pain and after one month hypoaesthesia and tingling alone remained. One year later, wasting and weakness of the intrinsic muscles was still observed but there was no disturbance of sensibility.

Case 4 (*Author's case*). Man aged sixty-four years. Farm labourer, brother of patient described in Case 3. Complained of numbness and tingling in the ring and little fingers, which had been present for seven weeks and was associated with pain in the forearm and weakness of grip.

On examination, there was some thickening of the ulnar nerve in the ulnar groove. Palpation caused paraesthesiae in the ring and little fingers. No palpable swelling. *Neurological findings : Motor*—Wasting and weakness of all the ulnar intrinsic muscles in the hand. *Sensory*—Hypoaesthesia in the whole of the ulnar nerve distribution. *Radiographs* showed marked osteoarthritic changes in the elbow joint.

Operation—A ganglion lying on the deep aspect of the humeral head of flexor carpi ulnaris was found to be compressing the ulnar nerve. There were several perineural adhesions in the ulnar groove. After excision of the ganglion, anterior transposition was carried out.

Progress—Rapid relief of tingling and numbness. Seven months after operation all the ulnar intrinsic muscles were working strongly and apart from some hypoaesthesia, no sensory disturbance was noted.

GANGLIA AT THE WRIST

Case 5 (*Contributed by Mr J. C. Scott*)—Woman aged nineteen years. Complained of pins and needles in the ring and little fingers of the left hand associated with weakness of grip, cramp and inability to straighten the affected fingers. These symptoms had been present for the past seven months.

On examination, there was no visible or palpable abnormality at the elbow or wrist along the course of the ulnar nerve. *Neurological findings : Motor*—Wasting and weakness of the ulnar intrinsic muscles of the hand. *Sensory*—Hypoaesthesia and hypoalgesia in the ulnar border of the palm, extending distally to the distal joint of the little finger (Fig. 4). *Radiographs* showed no abnormality in the wrist or hand.

Operation—At the level of the pisiform bone a ganglion projecting anteriorly from the wrist joint through the flexor retinaculum was found to compress the main ulnar nerve bundle. The ganglion was excised and the flexor retinaculum divided. *Histology*—The wall of the cyst was formed of acellular, well orientated fibrous tissue, which showed occasional evidence of a synovial lining. There was some capillary proliferation in the fibrous tissue surrounding the cyst. The appearances were consistent with a simple ganglion.

Progress—One year later there was no detectable weakness of the intrinsic muscles and no evidence of sensory disturbance (Fig. 5).

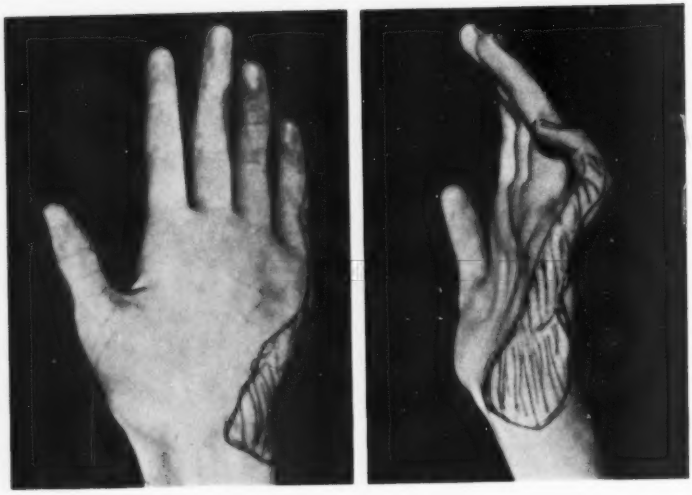

FIG. 4

Case 5—Area of sensory loss and wasting of ulnar intrinsic muscles of the hand with clawing of the fourth and fifth digits.

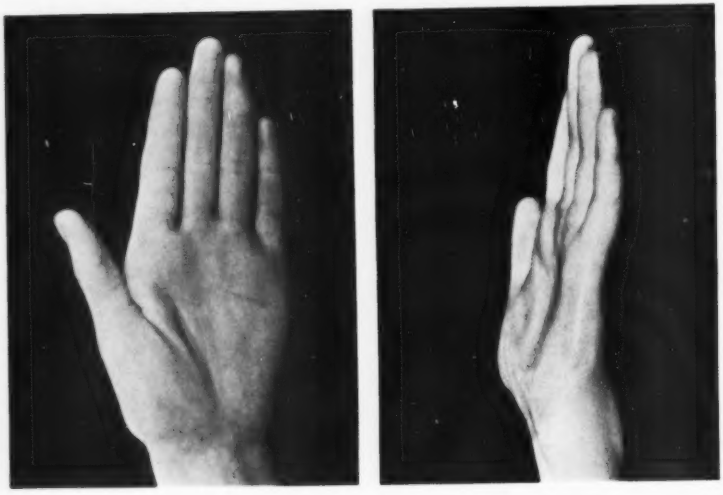

FIG. 5

Case 5—The same hand one year after operation, showing absence of clawing and increase of muscle volume.

Case 6 (*Author's case*). Man aged thirty-three years. Painter. Complained of inability to straighten fully the ring and little fingers of the right hand. He had noticed a swelling in front on the wrist joint and had experienced pain and tenderness in this region. His symptoms had been present for about six months.

On examination, there was a visible and palpable cystic swelling just proximal to the hypothenar eminence lying in the course of the ulnar nerve. *Neurological findings: Motor*—Wasting and weakness of the ulnar intrinsic muscles of the hand. *Sensory*—Hypoaesthesia and hypoalgesia in the cutaneous distribution of the ulnar nerve.

Operation—At operation a spherical cyst about 1·5 centimetres in diameter was found to arise from the margin of the insertion of flexor carpi ulnaris and could be seen to compress the main ulnar nerve trunk against the overlying deep fascia. Its contents were typical of a simple ganglion. The cyst was excised.

Progress—This patient did not return until seven years later, when he complained of a recurrence of the swelling and of the previous symptoms. *On examination*, there was clawing of the ring and little fingers. Proximal to the ulnar styloid there was a smooth systic swelling not attached to the skin, 1·3 × 2·5 centimetres. Palpation caused tingling and pain radiating proximally to the elbow. *Neurological findings: Motor*—Wasting and weakness of all the ulnar intrinsic muscles of the hand. *Sensory*—Anaesthesia of the hypothenar eminence and medial border of the palm, including the little finger.

Operation—A thin-walled ovoid cyst, 4 × 2 centimetres, was found arising from the anterior capsule of the wrist joint, growing proximally with the main trunk of the ulnar nerve stretched over it. The cyst was excised and the neck coagulated with diathermy. *Histology*—The cyst wall was vascular and the cyst was lined with hyaline fibrous tissue. The appearances were those of a ganglion. No nervous tissue was observed in its wall.

Progress—One year later all muscles were working strongly and there was no objective disturbance in sensibility.

Case 7 (*Contributed by J. Crawford Adams*)—Woman aged seventy years. Housewife. Complained of increasing difficulty in using the right hand for fine work such as sewing, for six months. A few weeks before the onset she had fallen heavily on the outstretched hand. Old unreduced fracture of the wrist had been suspected by her doctor because of an obvious deformity.

On examination, the deformity was found to be caused by a tensely cystic swelling immediately lateral to the pisiform bone. *Neurological findings: Motor*—Marked wasting of the ulnar-innervated muscles of the hand (Fig. 6). *Sensory*—Blunting of sensation in the ulnar distribution. *Radiographs* showed no abnormality.

Operation—A typical ganglion, 1·5 centimetres in diameter, was found immediately lateral to the pisiform bone. The part of the ulnar nerve just proximal to its division into superficial and deep terminal branches was stretched tightly over the ganglion. The ganglion was excised; it appeared to arise from the capsule of the piso-triquetral joint.

Progress—Four months after operation there was still marked wasting of the affected muscles, but function was already much improved as indicated by her ability to thread a needle and to resume fine sewing.

FIG. 6

Case 7—Photograph showing wasting, especially of the first dorsal interosseous muscle.

Case 8 (*Contributed by Mr H. Osmond-Clarke*—Woman aged forty-two years. Housewife. Complained of swelling of the left wrist for many years which was a nuisance chiefly in that it interfered with the wearing of a wrist-watch. It gave rise to no symptoms.

On examination, there was a typical ganglion in front of the wrist joint at the level of the proximal crease at the outer side of flexor carpi radialis. No motor or sensory disturbance was detected.

Operation—The ganglion was identified lying to the lateral side of flexor carpi radialis and proved to be about 1·5 centimetres long and 0·8 centimetres broad. It was excised. The point of origin was not definitely established.

Progress—No further trouble occurred until almost eighteen months later when pain radiating to the tip of the middle finger was experienced. No injury could be recalled. The pain gradually increased and gave way to numbness of the index and middle fingers and hypersensitivity of the thumb. There was also a generalised discomfort in the hand. *On examination*, there was found to be no clinical evidence of recurrence of the ganglion but marked tenderness was noted in the line of the median nerve 1·3 centimetres above the proximal wrist crease, with possibly some thickening in that region. *Neurological findings: Motor*—Slight wasting and weakness of the thenar muscles. *Sensory*—Complete anaesthesia of the tip of the index and middle fingers with hypoaesthesia in the rest of the median area except for hyperaesthesia on the front of the thumb.
Operation—The median nerve was exposed. No abnormality was detected at this stage but during the dissection of the nerve from the surrounding areolar tissue a small tense ganglion, 9×6 millimetres, was found to be indenting its deep surface. No connection with the surrounding tissues could be established. This second ganglion lay 1 centimetre proximal to that found at the previous operation and well towards the midline. It was remarked at the time that the symptoms were identical with that of a median nerve carpal tunnel compression syndrome.
Progress—All subjective and objective disturbance of sensibility disappeared rapidly and eighteen months later no motor or sensory disturbance could be detected.

GANGLIA NEAR THE KNEE

Case 9 (*Contributed by Mr H. L.-C. Wood*)—Man aged fifty-five years. Labourer. Complained of pain and numbness in the left foot, of one month's duration.
On examination, there was a cystic swelling, $1{\cdot}5 \times 3{\cdot}5$ centimetres below the head of the fibula in the course of the lateral popliteal nerve. The swelling was translucent. *Neurological findings: Motor*—No wasting, but weakness of all the lateral popliteal group. Electrical reactions showed evidence of a partial degenerative nerve lesion. *Sensory*—Anaesthesia of the dorsal aspect of the first digital cleft.
Operation—A ganglion was found firmly adherent to the lateral popliteal nerve and to the capsule of the superior tibio-fibula joint from which it appeared to arise. It was excised.
Progress—Six months later there was no evidence of motor or sensory disturbance.

Case 10 (*Contributed by Mr P. H. Newman*)—Woman aged sixty-seven years. Housewife. Complained of weakness and swelling of the left foot over a period of four years. Four months previously she had "sprained" her ankle.
On examination, there was an ill-defined swelling situated in the proximal third of the anterior compartment of the leg, deep to the deep fascia. *Neurological findings: Motor*—Complete paralysis of all the lateral popliteal innervated muscles with the exception of the peronei, which were normal. *Sensory*—Anaesthesia of the dorsal aspect of the first digital cleft. *Radiographs* showed no abnormality of the knee or superior tibio-fibula joint.
Operation—Lying between the tibialis anterior and the extensor digitorum longus a small cystic swelling was found extending up to the superior tibio-fibular joint. The neck of the sack ran anterior to the interosseous membrane and crossed in front of the anterior tibial nerve. The cyst was excised. *Histology*—The fibrous capsule of the superior tibio-fibular joint presented numerous small cysts extending through to the surrounding muscles. The cysts did not show a synovial lining and their structure was similar to that seen in a ganglion.
Progress—Three months later there was no evidence of return of voluntary power in the paralysed muscles but pain had disappeared completely and sensibility was almost normal.

Case 11 (*Author's case*)—Man aged forty-four years. Storekeeper. Six years before had complained of pain in the left leg radiating down to the great toe which became so severe that he was unable to get about. He recalled no specific injury to the limb. He had in-patient hospital treatment with physiotherapy for eight weeks and was then able to return to duty with complete disappearance of symptoms. One year later he had a further attack of pain which was relieved by similar treatment. Five years later he noticed a lump behind the outer side of the knee.
On examination, a hard tender swelling, 1×3 centimetres, was palpable in the course of the lateral popliteal nerve proximal to the head of the fibula. There was also a diffuse soft swelling, 6×3 centimetres, arising below the head of the fibula (Fig. 7). Palpation caused local pain and pain radiating in the distribution of the lateral popliteal nerve. *Neurological findings: Motor*—Slight weakness of the peronei only. *Sensory*—Anaesthesia in the distribution of the lateral popliteal nerve (Fig. 7). *Radiographs* showed no abnormality in the knee or superior tibio-fibula joint.

FIG. 7

Case 11—The continuous outline shows the area of sensory loss. The stippled outline shows the extent of palpable swelling.

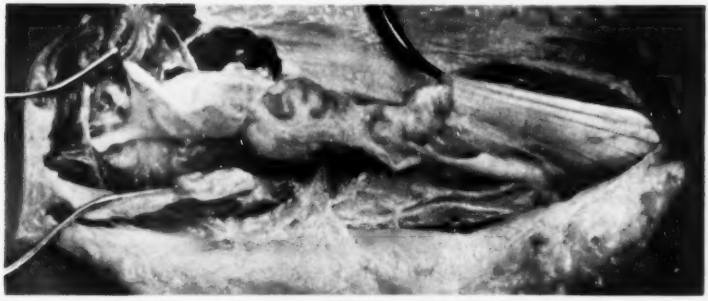

FIG. 8

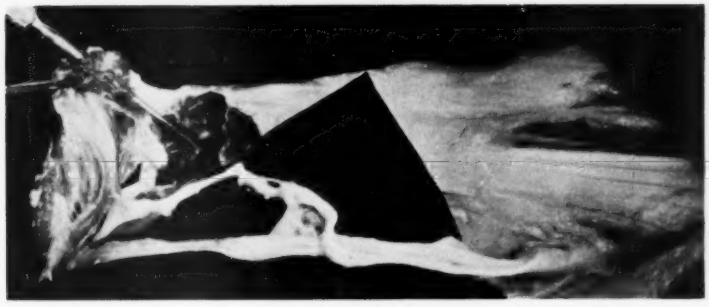

FIG. 9

Case 11—Figure 8 shows a stage during excision of the ganglion. Figure 9—After excision of the ganglion, showing the nerve flattened and attenuated.

Operation—A cystic ganglionic swelling involving the lateral popliteal nerve was discovered. It was 10 centimetres long × 2·5 centimetres in diameter at its widest part (Figs. 8 and 9). It had insinuated itself *between* the nerve bundles. When the swelling had been dissected from the nerve it was found to originate in the superior tibio-fibula joint. During excision, which was difficult, some nerve fibres had to be sacrificed. *Histology*—The histological features were those of a ganglion, its walls consisting of mucoid connective tissue surrounded by a layer of denser fibrous tissue. No synovial lining was present.
Progress—There was a complete lateral popliteal paralysis after operation. One year later there was no anaesthesia and the peronei had fully recovered. There was no certain recovery in the other muscles of the lateral popliteal group. Pain had disappeared.

GANGLIA NEAR THE ANKLE AND FOOT

Case 12 *(Contributed by Mr Lloyd Williamson)*—Woman aged forty-six years. Housewife. Complained of lump on the inner side of the left ankle which had been present for two months and which had recently become painful. It was associated with a feeling of numbness in the heel. *On examination*, a tense, ill-defined elastic swelling 3 centimetres in diameter was felt below the medial malleolus. It was not tender, but pressure caused a feeling of numbness on the medial side of the heel. *Neurological findings: Motor*—No wasting or muscle weakness detected. *Sensory*—Hypoaesthesia localised to the under surface of the heel. *Radiographs* showed no abnormality in the ankle or foot.
Operation—A ganglion becoming superficial between the tendons of tibialis posterior and flexor digitorum longus was found to compress the deep surface of the neurovascular bundle, which was stretched over it. The ganglion passed down to the ankle joint but had no obvious connection with it. Complete excision.
Progress—Six weeks later there was no subjective or objective disturbance of sensibility.

Case 13 *(Contributed by Mr E. A. Nicoll)*—Woman aged forty-seven years. Housewife. Complained of intermittent attacks of severe pain in the right forefoot for almost a year. During the attacks the pain was severe enough to interfere with normal activities. There were periods of complete remission of pain. She later noticed alteration of sensibility on the dorsal aspect of the first digital cleft.
On examination, there was a suspicion of fullness at the proximal end of the first metatarsal interspace on the dorsum of the foot, associated with exquisite tenderness in this area. Pain was so intense that adequate examination was impossible. She was unable to bear weight on the foot. After an infiltration with procaine, the symptoms disappeared rapidly. *Neurological findings: Motor*—No muscle wasting or weakness detected. *Sensory*—Hypoaesthesia on the dorsal aspect of the first digital cleft. *Radiographs* of the foot showed no abnormality.

FIG. 10
Case 13—Showing recurrence of the ganglion at the site of excision.

Operation—A tense ganglion was found beneath the deep fascia between the first and second metatarsal bones compressing the digital nerve with its accompanying vessels. A segment of the nerve was removed in excising the ganglion. The ganglion was traced proximally as far as possible but no connection was established with any joint. The dorsal approach, however, limited a full exploration.
Progress—There was an immediate relief of symptoms. Six months later, however, the ganglion recurred and presented as a visible swelling on the dorsum of the foot (Fig. 10). On this occasion it was symptomless and was ruptured by digital pressure.

DISCUSSION

Etiology and pathology—It has been recognised for some time that a simple ganglion arising from a joint can cause compression of an adjacent nerve and interfere with its conductivity causing motor and sensory disturbances in the distribution of the nerve. Two typical reports of this condition were furnished by Walley in 1933 and De Sanctis in 1931. In the former the lateral popliteal nerve at the knee, and in the latter the ulnar nerve at the elbow, were compressed by ganglia arising from the superior tibio-fibula joint and elbow joint respectively.

In 1936 Ellis recorded two cases of ganglia in the sheath of the peroneal nerve in which a "cystic degeneration" of the nerve sheath was said to have occurred, giving rise to compression symptoms. The important characteristics of these cysts were that they lay within the sheath of the nerve trunk, displacing the nerve bundles, were lobulated, and had the macroscopic and microscopic features of simple ganglia. He referred to thirteen similar cases reported in the Continental literature. Most of these were histologically similar in every respect to ganglia. In a case reported by Wadstein (1931), the histology was described thus: "The cystic wall is made up of a cystic material that conveyed a definite impression of a synovial tissue. No nervous elements were found in the wall. It is in all probability a ganglion." However, the earliest case reported, that of Hartwell in 1901, from the pathological description was undoubtedly a schwannona. At least two other reported cases were, from the evidence, probably schwannomata (Sultan 1921, Zaar 1926).

The distinction between cystic degeneration of the nerve sheath and a simple ganglion seems to be anatomical rather than pathological, one being intraneural and the other extraneural. In Case 11 it is important to note that the ganglion was found to have penetrated the nerve sheath although a clear connection with the joint was established.

Those who consider that a ganglion of the nerve sheath is a separate entity maintain that trauma to the nerve is an important etiological factor. The ulnar nerve at the elbow is probably subjected to injury more frequently than any other peripheral nerve and yet traumatic ulnar neuritis is not associated with such a cystic degeneration. The evidence suggests, therefore, that the distinction between these two conditions may be artificial. In both the ganglion may arise from the neighbouring joint or may even be due to extra-articular synovial remnants unobliterated at the time of embryonic joint formation.

Diagnosis—The predominant symptom in half of the cases was pain in the distribution of the nerve. Next in frequency were muscle weakness or symptoms of numbness and tingling. Five patients volunteered the information that they had a "lump" and in nine instances a swelling was palpable. In Cases 4, 5 and 13 there was no palpable abnormality along the course of the nerve. The pain in Case 13 was comparable to that experienced with a glomus tumour and in the absence of any palpable swelling this might well have been the cause.

Treatment—The treatment of choice is undoubtedly excision of the ganglion and, when there is a connection with the neighbouring joint, cauterisation of the stalk. In those cases in which the ganglion has become firmly adherent in the nerve or has penetrated the nerve sheath as in Case 11, puncture is probably the safest course of treatment even though it may mean a recurrence later, because damage to the nerve fibres can occur during excision. In three of the four cases in which the ganglia occurred in relation to the elbow joint, there was an associated hypertrophic osteoarthritis of the joint, and, while the ganglion undoubtedly aggravated the ulnar neuritis, in two instances there was ample evidence of a lesion proximal to the site of compression. A striking contrast is provided by the remaining cases of compression in which no demonstrable arthritic changes were present in the adjacent joint.

Prognosis—The interruption of nerve conductivity in these instances is due to simple compression. The severity of the nerve lesion is dependent upon the degree and duration of

the compression. When compression is relieved conductivity is usually completely restored. The rate and quality of recovery depends on whether the lesion is predominantly a neurapraxia or axonotmesis.

SUMMARY

1. Thirteen cases are reported of nerve compression by a ganglion. At operation a connection between the ganglion and the neighbouring joint was established in many instances.
2. It is suggested that so-called ganglia of the nerve sheath and simple ganglia are anatomical varieties of the same entity.
3. The treatment of choice is excision of the ganglion. If this procedure is technically difficult, puncture is advisable.
4. Recovery of sensibility after operation was good. Motor recovery was poor when damage to motor fibres occurred during excision of the ganglion or when paralysis had been present for more than eighteen months.

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SOLITARY TUMOURS OF PERIPHERAL NERVE TRUNKS

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Primary solitary tumours of the peripheral nerve trunks are relatively infrequent. Three such tumours have been treated at Hammersmith Hospital during the last four years, but a search of the hospital records for the period 1939–1950 has not shown any similar cases. (Solitary tumours of the auditory nerve and spinal nerve roots are not included in this report.) In these three patients the tumour involved the radial, lateral popliteal and ulnar nerves respectively. In only one of them was the diagnosis made before operation.

A swelling arising from a main nerve trunk may be a traumatic false neuroma, a neurofibroma, a neurilemmoma or, more seldom, a neurofibrosarcoma. There are only two benign tumours which arise from nerve trunks. One of these is the neurilemmoma, which develops from the cells of Schwann, and with which this paper is mainly concerned; the other is the neurofibroma, which is derived from fibroblasts and will be discussed only in relation to the true neurilemmoma.

Nerve axons cannot give rise to tumours independently of their parent cells, but if damaged or divided they coil up into a mass of connective tissue and give rise to a false neuroma. Peripheral tumours of nerve cells can occur only in situations where there are nerve ganglia, as in the sympathetic plexuses or the thoracic root ganglia. They are included in the group of ganglion-neuromas, comprising less than one per cent of nerve tumours outside the central nervous system, and will not be discussed here.

NOMENCLATURE AND CELL OF ORIGIN

The three tumours reported here are regarded as benign tumours of the nerve sheath. These tumours are called by many names—neurilemmoma, Schwannoma, neurinoma, perineural fibroma or fibroblastoma, palisaded neuroma, peripheral glioma—and are frequently confused with the neurofibroma (Mayo and Barber 1934, Cutler and Gross 1936b) as indicated by Craig (1945). The term neurilemmoma (from *νευρον*—nerve, *λεμμα*—a closely adhering sheath, and *ομα*—a tumour) will be employed here.

There are two views on the origin of tumours of nerve sheaths. Masson (1932) and Stout (1935a), basing their theory on histological investigations, believed that the tumours are derived from the sheath cells of Schwann (Schwann 1847). They maintain that Schwann cells of the nerve sheaths are also responsible for the large areas of collagen and reticulin fibres that are interspersed between the cells. This view is supported by Nageotte (1932) and by Stewart and Copeland (1931), by the tissue culture studies of Murray and Stout (1940), and by the examination of a large bulk of material carried out by Willis (1948). Skinner (1929), from a study of neurilemmomas of the acoustic nerve, suggests that though the Schwann cells are the "type cell" the intercellular connective tissue of the tumour is in the nature of a tissue reaction and derived from the adjacent tissues.

The opposite view, that these tumours arise from the connective tissue fibroblasts of the perineurium or endoneurium, is put forward by Mallory (1914, 1920) and by Penfield (1927, 1932), whose theory is based on the assumption that tissues derived from ectoderm are incapable of forming the collagen and reticulin fibres which are invariably present. They therefore apply the name perineural fibroblastoma to them. Tarlov (1940) has supported this by special staining techniques. Even in a normal nerve trunk it is difficult to distinguish

between the endoneurium and the Schwann-cell syncytium and the difficulty is greater in the case of a nerve tumour.

Both schools admit that the Schwann cells of a normal nerve sheath are derived from the neural crest and are therefore ectodermal in origin, as demonstrated by Harrison (1908, 1924) and Harvey *et al.* (1926, 1933).

Patients with solitary neurilemmomas may show associated characteristics of von Recklinghausen's disease, and neurilemmal tissue is frequently found in true neurofibromata (Penfield 1927). There is therefore difficulty in deciding the origin of the neurofibromata and in determining the relationship between the neurofibromata and the true nerve sheath tumours. Foot (1945) has suggested that they may be a scirrhous form of neurilemmoma. In a neurofibroma, however, the parent nerve appears to be expanded by a diffuse increase of all the sheath tissues with separation of the nerve fibres and bundles as they traverse the swelling. This may not be a true tumour at all, but a "hamartoma"—a tumour-like malformation with the tissues in improper proportion or distribution and a prominent excess of one particular tissue (Albrecht 1904, Willis 1948). Trotter (1926) believed that the fibromatous formation of a neurofibroma was due to a deficiency of the normal nerve sheaths, as a result of which the non-insulated nerve fibres give rise to fibrosis by local irritation of the adjacent tissues—in much the same way as a foreign body would. Willis indicates that generalised neurofibromatosis predisposes to the development of a true tumour, either a neurilemmoma or a localised progressive fibroma or a malignant sarcoma, superimposed on the original lesion. Similar views are expressed by Worster-Drought *et al.* (1937) and by Bailey and Herrmann (1938).

INCIDENCE AND SITE

The incidence is about the same in both sexes and these tumours have been found from infancy to old age. It is difficult to assess the true incidence of neurilemmomas as they are often unrecognised; it is equally difficult to assess their incidence in different situations, as most of the cases have been reported in the literature of special groups.

Neurilemmomas usually arise as solitary tumours from the main nerve trunks. Stout (1935a) reviewed 194 previously published cases and added fifty additional ones; of these the majority of tumours were derived from main nerve trunks. More recently Money (1950) reported thirteen neurilemmomas amongst 360,672 patients over a period of thirty-eight years; of these seven were from major nerve trunks. Sjövall (1937) found seventy nerve tumours in 31,331 necropsies but failed to distinguish between neurilemmomas and neurofibromas.

Several authors (Mayo and Barber 1934, Cutler and Gross 1936b) record these tumours as "solitary neurofibromas not associated with von Recklinghausen's disease," but from the descriptions and photographs it is evident that at least some of them could have been neurilemmomas.

In addition to the peripheral nerves of the limbs, the cranial nerves also give rise to neurilemmomas. The auditory nerve is the most frequent site inside the skull; in the neck the facial nerve (Loeliger 1947), the glossopharyngeal nerve (Cedermark 1949), the vagus (Tarlov 1940, Murley 1948, Paul 1949) and the hypoglossal nerve (Friedman and Eisenberg 1935, Haase 1946) may be affected. Gordon-Taylor (1940) recorded a tumour probably arising from either the glossopharyngeal or the vagus nerve which exactly simulated a carotid body tumour clinically and at operation. The cervical sympathetic trunk also may give rise to a neurilemmoma (Callum 1949). Thirteen of Stout's (1935a) series of fifty tumours occurred in the head and neck, and Ehrlich and Martin (1943) found that 43 per cent were in this situation; but this high incidence may be due to the relatively large numbers of head and neck tumours treated at the Memorial Hospital, New York.

These tumours may also grow from the spinal nerve roots and give rise to symptoms of spinal cord compression (Elsberg 1925, Rogers 1948), or they may extend outwards through

the intervertebral foramen, which constricts the tumour to a "dumb-bell" (Eden 1941). Occasionally a neurilemmoma may occur in the subcutaneous tissues, but they never develop in the dermis (Biggart 1949).

The stomach is a relatively common site for a neurilemmoma (Minnes and Geschickter 1936, Ransom and Kay 1940), and a peculiar epithelioid type of the tumour described by Willis (1948) grows in this situation but has not been reported as occurring elsewhere. Other less frequent sites are the tongue (Stout 1935a), the sympathetic nerves (presumably derived from the Remak sheath cells, which are the counterpart of Schwann cells of myelinated nerves) and the skeleton (de Santo and Burgess 1940). Only three of the tumours have been described in bone and one of these appears to have been due to secondary invasion of the sacrum by a neurilemmoma of a spinal nerve root. The osseous lesions present as simple, clearly defined defects in the affected bones and are wholly unlike the typical bone lesions of von Recklinghausen's disease of nerves.

CLINICAL FEATURES

The solitary neurilemmoma of a peripheral nerve trunk usually presents as a symptomless swelling discovered accidentally by the patient, which has been present for several years before he seeks treatment (Lewis and Hart 1930, Stout 1935b). Even with large tumours, interference with nerve conduction is unusual (Ewing 1940). If the affected nerve and its tumour are lying in a lax intermuscular plane, pressure-effects—paresis or analgesia—are less likely to occur (Case 1) than if the nerve is in contact with unyielding bone (Case 2) or enclosed in a restricted fascial compartment (Case 3). Motor or sensory disturbances alone do not indicate malignancy, as suggested by some authors. There is usually no discomfort except in response to external pressure.

In the limbs, neurilemmomas occur most often in the front of the arms and the back of the legs—that is, on the flexor aspects, which is to be expected from the anatomical distribution of the main nerve trunks. The swelling is usually movable from side to side but the nerve prevents its being moved in the long axis of the limb. If the tumour is near the surface and has undergone extensive cystic degeneration it may be transilluminated.

PATHOLOGY

Neurilemmomas are well circumscribed encapsulated tumours with the bundles of the parent nerve passing to one side or spread out over the surface of the tumour (Livingston and Hastings 1947). Neurofibromata are less well defined at the edges and may blend with the surrounding tissue; they often infiltrate the parent nerve, with thickening of its trunk for a variable distance beyond the main tumour mass. Nerve bundles traverse the centre of the neurofibroma instead of passing to one side (Willis 1948). A neurilemmoma may be firm and fibrous but it frequently undergoes cystic degeneration; a neurofibroma is always solid and never becomes completely cystic. The three tumours recorded here had undergone extensive cystic degeneration and their appearance at operation was identical, though the histological picture varied (Figs. 1, 6 and 8).

Most neurilemmomas are solitary (Stout 1946) but true neurofibromas are almost always multiple (Barnard and Robb-Smith 1945). However, neurilemmomas may occasionally develop in addition to neurofibromas in multiple neurofibromatosis. Conversely, though a solitary nerve tumour is nearly always a neurilemmoma, it may occasionally be a true neurofibroma (Willis 1948).

Histology—Neurilemmomas show a palisade arrangement of cells in parallel rows with intervening fasciculated bands of collagen or reticulin fibres which can be demonstrated by silver stains (Fig. 4). The cells may also be arranged in whorls. Both the palisading and the whorls are referred to as Verocay bodies (Verocay 1908, 1910), after the author who first described them and differentiated the specific neurilemmoma of the nerve sheath from the

neurofibroma). A neurilemmoma may be solid with a well defined orderly arrangement of cells and fibres (Fig. 2), or there may be many areas of myxomatous cystic degeneration with a looser texture and more haphazard reticulated arrangement of the fibres and the cells. These are known as Type A and Type B tissue respectively (Antoni 1920) and are frequently present in the same tumour (Fig. 3). The cystic areas in Antoni type B tissue may coalesce and form larger cysts (Fig. 3). Stout (1935b) and Cutler and Gross (1936a, 1936b) have described tumours which appear to be entirely cystic and in which the typical structure of the neurilemmoma has been replaced by a fibrous capsule. Other authors (Wadstein 1931, Ferguson 1937) refer to these cystic tumours as "ganglia" of the nerve trunks. All these cysts are probably degenerate nerve tumours; there seems no reason to suppose that either a normal or an injured nerve trunk will undergo cystic degeneration.

A similar cystic change had developed in the second and third cases of the series. It seems likely that the central cystic degeneration of a neurilemmoma with distension of the

FIG. 1

Case 1—The sausage-shaped semi-cystic tumour of the radial nerve lying on the surface of the brachialis anterior muscle. The nerve trunk can be seen entering and leaving the tumour with the fibres spread out over its surfaces, especially at the upper pole.

tumour will destroy the tumour cells but leave the more resistant intercellular fibrous tissue as a capsule. Injury appears to initiate or accelerate cystic degeneration (Case 3). Such a change would be more likely where the nerve is passing through a rigid compartment, like that surrounding the ulnar nerve at the wrist (Case 3), or where it lies in direct contact with unyielding bone (Case 2). The cellularity of the cyst wall in Case 2 (Fig. 7) suggests a transitional stage between the typical histological appearance of Case 1 and the simple cyst with a fibrous capsule where the cystic degeneration is complete (Case 3).

Malignant change—Tumours arising from Schwann cells are benign, and local enucleation does not appear to initiate malignant change (Stout 1946). Even if the tumour is incompletely removed in an effort to preserve the continuity of the nerve trunk, local recurrence is infrequent: there was only one local recurrence in Stout's series of 144 cases and this tumour did not become malignant (Stout 1946). But the neurofibromata of von Recklinghausen's disease are liable to malignant change and it appears that operative intervention increases this risk, especially if the tumour is incompletely removed (Speed 1942, Aird 1949). It is therefore of great importance that these two types of nerve tumour should be differentiated before any attempt is made at surgical treatment. It is better to avoid surgical intervention with a

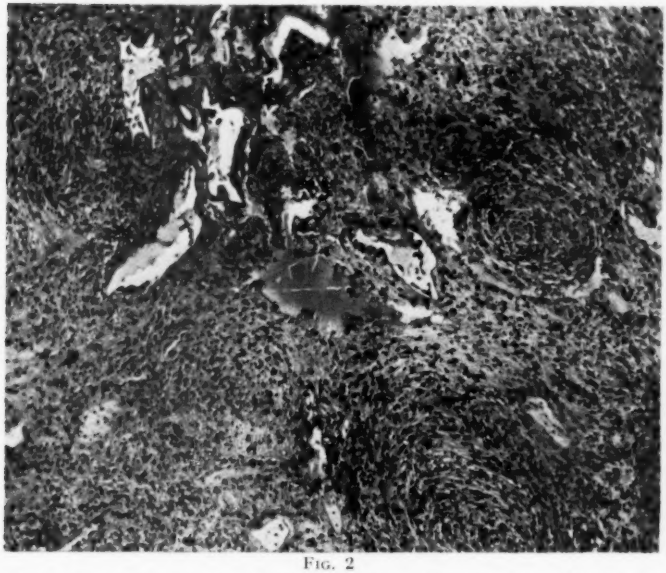

FIG. 2

Case 1—The excised tumour. Low magnification. Two compact whorls of cells and fibres (Verocay bodies) are seen surrounded by more loosely arranged tissues in which there are numerous minute cystic spaces (Antoni B tissue). In the centre there are large areas of myxomatous degeneration without cell nuclei and some of these are already converted into irregular cystic spaces. As degeneration progresses the cysts coalesce and will ultimately form a single large cyst.

FIG. 3

FIG. 4

Case 1. Figure 3—High power view, showing the typical palisaded arrangement of the nuclei with orderly collagen fibres between the rows of cells (Antoni type A tissue). Figure 4—Section stained with a silver stain to demonstrate the arrangement of the reticulin fibres.

neurofibroma, but if an operation is necessary it is safer to resect the affected nerve trunk with the tumour (Cutler and Gross 1936a, Aird 1949).

The failure to differentiate between neurofibromas and neurilemmomas in many of the reported cases of apparently benign nerve tumours becoming malignant (Geschickter 1935, Cutler and Gross 1936b) makes it difficult to assess the relative liability of these two types of nerve tumour to malignant change, though it is known that many patients with multiple neurofibromatosis develop malignant neurofibrosarcoma (Garrè 1892, Hosoi 1931, Geschickter 1935). The solitary neurilemmoma is essentially a benign tumour and there is no proof that it ever becomes malignant, though on rare occasions a locally malignant nerve tumour has been suspected of originating from a benign neurilemmoma (Cutler and Gross 1936b). Four out of five malignant neurofibrosarcomata arise from pre-existing benign neurofibromata (Stout 1935a, Stout *et al.* 1937), and they seldom show histological evidence of neurilemmomatous structure (Willis 1948). Their structure and behaviour are similar to that of other sarcomata of the connective tissues (Stewart and Copeland 1931, Quick and Cutler 1927). There is no evidence to suggest that they arise from neurilemmal tissue.

TREATMENT

Solitary nerve tumours are usually neurilemmomas and can be enucleated completely by careful dissection. The nerve bundles are spread out over the surface of the tumour and it may be necessary to split the nerve longitudinally to gain access to it (Cutler and Gross 1936a). The injury inflicted on the nerve by the operation is likely to cause temporary paresis and hypoaesthesia in the affected area (Case 1) or to increase any such disability which may have been present before operation (Case 2). Nerve conduction usually recovers rapidly and the operation should later lead to a full return of function by relieving the pressure on the nerve.

If the tumour cannot be enucleated it is probably not a neurilemmoma but a neurofibroma, the nerve fibres running through the centre of the tumour instead of round it. Such tumours can be removed only by excision of the affected nerve segment with suture of the divided ends (Cutler and Gross 1936a). Because of the liability of this type of tumour to undergo malignant change it is probably unwise to attempt a simple enucleation (Speed 1942) or even biopsy unless clinical features—such as pain or increased size of the tumour—suggest that malignant change may already have taken place. Under these circumstances the suspected tumour should be widely extirpated, with its parent nerve (Herrmann 1950). All tumours removed at operation, however benign their macroscopic appearance, should be examined histologically for evidence of malignant change.

CASE REPORTS

Case 1—A woman aged sixty-seven sought advice for a symptomless swelling of the right arm which had been present for several months. She did not think it was getting larger, but she was anxious to have it removed.

On examination there was no visible external swelling, but on palpation a firm and slightly tender mass could be felt in the soft tissues over the lateral aspect of the distal third of the right upper arm. It was not attached to the overlying skin or to the underlying bone. The swelling was oval in shape and approximately one inch long, with its long axis in the line of the limb. It could readily be moved from side to side but would not move in the long axis of the arm. It became fixed by resisted flexion of the elbow. Its position was not affected by movements of the elbow and it was thought to be embedded in the substance of the brachialis muscle or the lateral intermuscular septum. There were no palpable axillary glands, no muscle weakness and no alteration in skin sensation. *At operation* in June 1947, the swelling was found to lie between the outer margin of the brachialis and the upper limit of the brachio-radialis muscles and in front of the lateral aspect of the triceps. With further dissection it became evident that the tumour was intimately connected with the trunk of the radial nerve (Fig. 1). The nerve bundles were spread out over the surface of the tumour and it was found possible to enucleate the tumour completely from the nerve by careful dissection. The external appearance was similar to that of a simple ganglion, and during the

FIG. 5

FIG. 6

Case 2. Figure 5—The swelling over the head and neck of the fibula. Note the extensor paresis of the first toe. Figure 6—The multilocular cystic tumour of the lateral popliteal nerve with the nerve bundles spread over the anterior and outer aspects of the tumour.

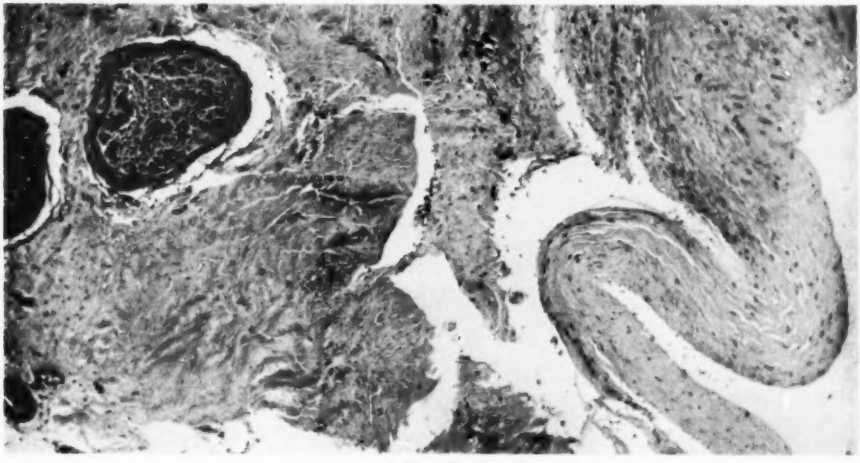

FIG. 7

Case 2—The collagenous wall of one of the large cystic spaces. Two small nerves can be seen in the adventitia at the opposite side of the field.

operation the capsule was inadvertently torn with the escape of clear gelatinous fluid. The radial nerve was preserved and at the close of the operation lay in its normal intermuscular plane.

Progress—The operation was followed by an incomplete radial nerve palsy, which recovered completely within three months. On examination three years later there was no recurrence of the swelling and there were full power and movement and normal sensation in the arm.

Histology—The sections showed a typical neurilemmoma with the cell nuclei arranged in rows and whorls with bands of collagenous fibres between (Figs. 2 and 3). In other areas the cells and fibres were irregularly arranged, with myxomatous degeneration and numerous small cystic spaces coalescing in places to form larger cysts (Fig. 2). Silver impregnation demonstrated many reticulin fibres (Fig. 4).

Case 2—A man aged forty-five was admitted to hospital in December 1949 with intermittent pain over the outer and anterior aspect of the left leg below the knee, in the region supplied by the lateral popliteal nerve. Recently he had noticed cramp when kneeling which had become worse in the previous four months. During the same period he had noticed a lump in the region of the head of the fibula which when touched produced a tingling sensation in the leg.

On examination there was a firm rounded swelling, approximately one inch in diameter, behind the head of the left fibula (Fig. 5). Although its centre appeared to be subcutaneous, it was intimately attached to the deep structures. The swelling was mobile across the axis of the limb but could not be moved longitudinally. Skin sensation was diminished to touch and pin-prick in the distribution of the lateral popliteal nerve, and there was well marked impairment of power of all the anterior crural and peroneal group of muscles. The extensor hallucis longus was completely paralysed.

Operation—The lateral popliteal nerve was exposed proximal to the tumour and followed down behind the fibula. At this point a cystic swelling approximately one and a half inches long and half an inch across was found lying underneath the gastrocnemius and behind the peroneal muscles (Fig. 6). The cyst was multilocular, with the branches of the nerve spread out over its anterior and superficial surface, with the loculi of the cyst herniating between the branches. The cyst was dissected away from the nerve with some difficulty and was punctured, with the escape of glairy fluid similar to that seen in a ganglion. The branches of the nerve were directly stimulated by faradic current: the peroneal muscles contracted strongly but none of the anterior crural muscles responded to the stimulus.

Progress—On the day after the operation there was complete paralysis of the anterior crural muscles and weakness (M3) of the peronei. There was no further decrease in the skin sensation. A month later the patient was discharged; he walked with a hinged inside below-knee iron, an outside T-strap and a toe-lifting spring. The tibialis anterior muscle had already recovered weak voluntary contraction. The paralysed muscles slowly recovered, and seven months after operation there was full normal power in all of them except the extensor hallucis longus, of which the strength was only M3. The affected muscles were therefore much stronger than before the tumour was removed. When last examined a year after operation there was full power of all the muscles, with normal skin sensation and no evidence of any recurrence of the tumour.

Histology—The microscopic sections showed that the tumour had undergone extensive cystic degeneration and some of the cysts had coalesced to form relatively large cavities surrounded by collagenous scar tissue. The wall of one of these cysts is shown in Figure 7.

Comment—Ferguson (1937) and Cutler and Gross (1936b) reported similar cases and Wadstein (1931) reported two cases and reviewed five others. It appears that the lateral popliteal nerve at this level is particularly liable to the formation of these cystic tumours.

Case 3—A woman aged fifty-one injured her hand slightly at housework in February 1950. She had immediate intense pain in the ulnar side of the hand, which passed off after a few minutes. A week later paraesthesiae and aching developed in the fourth and fifth fingers, and later there was progressive weakness and flexion deformity of these fingers with shrinkage of the hypothenar eminence. She attended hospital two months later. On examination there was analgesia to light touch and pin-prick in the distribution of the ulnar nerve in the hand and fingers. The hypothenar muscles were grossly wasted and typical deformity of the fourth and fifth fingers was present—flexion of the interphalangeal and extension of the metacarpo-phalangeal joints. It was thought that the disability was due to a direct contusion of the ulnar nerve and its adjacent tissues, and the patient was treated conservatively.

The sensory disturbance gradually recovered but the paresis and deformity persisted. Eight months after the original injury there was a palpable tender swelling of the ulnar nerve at the level of the pisiform. This was thought to be a traumatic neuroma. The hypothenar and interosseous muscles were severely wasted and voluntary straight finger flexion of the fourth and fifth fingers was impossible. Electrical stimulation of the nerve above the lesion produced contraction of all the muscles with the exception of the interossei. The nerve lesion was evidently incomplete and involved the deep branch of the ulnar nerve. Because of the swelling and the failure to respond to conservative treatment it was decided to explore the ulnar nerve at the wrist.

Operation—A cystic tumour of the ulnar nerve was found arising mainly from the deep branch and burrowing between the abductor and flexor digiti minimi, with the nerve bundles spread out

FIG. 8

FIG. 9

Case 3. Figure 8—The cystic tumour of the ulnar nerve (from a sketch made at operation). Figure 9—Cyst wall composed entirely of fibrous tissue which has replaced the tumour tissue.

over its anterior and medial surface (Fig. 8). The superficial branch of the nerve also was in intimate contact with the tumour but was not compressed or distorted. The tumour was carefully dissected away from the nerve but it was found necessary to excise the pisiform to obtain access to the deepest part. During the dissection the cyst was punctured, with the escape of glairy mucinous fluid.

Progress—Immediately after the operation there was a transient hypoaesthesia of the fourth and fifth fingers which resolved within a week. Six months later the voluntary power of all the affected muscles had increased and their response to galvanism was much stronger. Some weakness still persisted, however, and, as in severe injuries of the ulnar nerve at a higher level (McGowan 1950), it appears unlikely that full recovery of motor function will be obtained.

Histology—The microscopic sections showed complete cystic degeneration with a collagenous wall but no lining cells. In this specimen no residual true tumour tissue could be found (Fig. 9). Although no neurilemmal tumour tissue was present, because of its anatomy and clinical behaviour it was regarded as a neurilemmoma that had undergone complete degeneration. Similar extensive and sometimes complete cystic degeneration has been demonstrated in many of the previously published cases already discussed.

SUMMARY AND CONCLUSIONS

1. Three solitary tumours of the peripheral nerve trunks are reported. None of the patients showed evidence of von Recklinghausen's disease.

2. The origin of these tumours is discussed; the evidence suggests that they develop from the Schwann cells of the nerve sheaths, and they should therefore be called neurilemmomas.

3. A solitary tumour of a peripheral nerve trunk is usually a neurilemmoma and not a neurofibroma.

4. These tumours are often mistaken for neurofibromas, from which they are wholly distinct. They are uncommon, but probably occur more often than is generally appreciated.

5. A neurilemmoma is a benign tumour which can be distinguished from a neurofibroma on clinical and operative grounds. It must be enucleated with preservation of its parent nerve. There is negligible risk of recurrence and no risk of malignant change after operation.
6. Neurilemmomas are liable to cystic degeneration, especially in situations where they are subjected to pressure or injury. This cystic change may later destroy the usual cellular structure of the tumour and convert it into a simple cyst.

I am grateful to Mr Charles Gray for allowing me to publish the second case in this series and to Professor Ian Aird and Dr C. V. Harrison for their helpful criticism. For the photographs I am indebted to Mr E. V. Willmot and Mr K. G. Morman and for the drawing of the third case to Miss Helen Wilson.

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HAEMOPHILIAC ARTHROPATHY OF THE HIP

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It is well known that the recurrent haemorrhages which occur into the knees of some haemophiliacs may produce permanent changes in those joints. It is less well known that the hips can be affected and that rather characteristic changes can occur in the epiphyses of the femoral heads. This paper presents some details of seven haemophiliacs whose hips were affected in this way.

Our knowledge of haemophiliac arthropathy has been based mainly on experience with the knee, the ankle and the elbow. The most recent surveys of the problem by Thomas (1936) and by Ghormley and Clegg (1948) report very few cases of hip joint affections, and do not describe these in any detail. The hip has received more attention in reviews of smaller series of cases. In 1930 Löhr reported two cases of arthritis of the hip in haemophilia, and reviewed other reports published by Engel, Montanari, Petersen, Assman, Reinicke and Wohlwill, Llopis and Schlossman. In all, this series reported seven adults and six children. Keefer and Myers (1933) reported four similar cases in adults and one in a child, but only one of them showed radiographic changes. McDonald and Lozner (1943) reported one adult with radiographic changes in the hip, and Newcomer (1939) reported two adults, neither of whom showed radiographic changes. Caffey and Schlesinger (1940) reported one case in a boy of ten. Kahn (1934) and Solis-Cohen and Levine (1934) also mention cases. Prip Buus (1935) reported one case in an adult with radiographic changes.

Lamy (1942) described radiographic changes in the head of the radius in haemophiliac arthritis of the elbow. The radial head was flattened and cup-shaped, and cysts were noted in the epiphysis. Morrissette (1944) also reported similar changes in the radial head, and described involvement of the wrist with almost complete disappearance of the scaphoid and lunate. This type of change strikingly resembles some of the changes in the femoral head in the cases under consideration here.

In haemophiliac arthropathy, the haemorrhage may be intra-articular or intra-osseous, and in the past attention has been drawn mainly to the haemarthrosis, with the swollen distended joint in the acute phase, and the limitation of movement, contractures, and fibrous ankylosis which may develop later. The observations on intra-osseous haemorrhage have usually been confined to the observation of bone cysts, and in the hip not even these have been described often.

In the few available papers, there is little beyond the statement that changes occur which resemble Perthes' disease and osteoarthritis. Little attempt has been made to explain the mechanism of the production of the changes, or to point out the differences between pseudocoxalgia and the changes in haemophiliac arthropathy. Little comment has been made on the relative importance of the intra-articular and intra-osseous haemorrhage, and no attempt made to point out the possible importance of the intra-osseous haemorrhage in relation to other diseases of the hip. It is the purpose of this paper to draw attention to the importance of the intra-osseous changes, and to their possible significance in the pathology of the hip.

CASE REPORTS

Case 1—The patient was a boy in whom the tendency to bleed easily was noticed at the age of twelve months, when he developed a large haematoma in one arm. After the age of three he had numerous attacks of nose bleeding, which were always severe. At the age of six he bled profusely

FIG. 1

FIG. 2

Case 1—Boy aged ten with proven haemophilia. No symptoms referable to the hip. Clinically, limitation of abduction and medial rotation. Initial radiograph (Fig. 1) shows flattening, irregularity and increased density of the left capital epiphysis. Figure 2—Two and a half years later, there is considerable flattening of the epiphysis and broadening of the neck.

after the extraction of two teeth, and had to have a blood transfusion. A severe epistaxis at the age of eight required a further transfusion. He was referred to the Rochdale Orthopaedic Clinic at the age of ten, complaining of pain and swelling of the left knee. There were no symptoms directly referable to the hip joint, but attention was drawn to it by his gait, which was a typical "stiff-hip" limp. There was restriction of abduction and internal rotation of the hip, and a radiograph showed considerable flattening, irregularity and increased density of the capital epiphysis on the left side (Fig. 1). He had further attacks of pain and swelling of the left knee, and was admitted to hospital eight months later. He remained in hospital for eight months and has had further similar incidents since his discharge. He has never had symptoms in his left hip. Radiographs taken two and a half years after the first examination showed that the flattening of the epiphysis had increased, and that the epiphysis was now represented by a thin strip on the expanded neck (Fig. 2).

Blood examination—Whole blood clotting time (Lee and White at 37 degrees Centigrade*) was as follows: first tube, 28 minutes; second tube, over 30 minutes. Plasma clotting time, 8 minutes. Prothrombin activity was 40 per cent. Serum prothrombin time was: after 4 hours, 12 seconds; after 24 hours, 12 seconds.

Blood count showed red blood cells 4,400,000, haemoglobin 89 per cent; colour index 1·01; white blood cells 7,200; and platelets 208,000.

Case 2—This patient had his first spontaneous haemorrhage at the age of twelve months. From this time onwards he was never out of hospital for more than two or three months. He had several severe haemorrhages from lacerations of the tongue, from nose bleedings and from minor cuts. Transfusions were given on several occasions. At the age of three he fell while running along the ward. He complained of pain in

FIG. 3

Case 2—Boy aged ten with proven haemophilia. No symptoms referable to the hip. Clinically, limitation of abduction and internal rotation. Note flattened capital epiphysis on the expanded neck.

* Normal readings for this method are as follows. Whole blood clotting time (Lee and White at 37 degrees Centigrade): first tube, 3½ to 5½ minutes; second tube, 5½ to 7½ minutes; third tube, 7½ to 10 minutes. Plasma clotting time, 1¾ to 3½ minutes.

the left hip, but radiographs were normal. One year later he was admitted with a large haematoma in the region of the right hip. At this time his bleeding time and coagulation time were normal, and indeed it was not until he was five years old that the clotting time was found to be prolonged to fourteen minutes. He was referred to the Orthopaedic Department at Stepping

FIG. 4

FIG. 5

Case 3.—Male child aged eighteen months. Proven to have haemophilia. He had a limp and there was limitation of abduction of the left hip. Initial radiograph showed a small capital epiphysis on the left side (Fig. 4). Further radiograph taken twelve years later (Fig. 5) showed a short distorted neck, with the remains of the flattened epiphysis on the postero-superior aspect.

Hill Hospital at the age of ten, with a flexion contracture of the left knee. There was marked restriction of medial rotation and of abduction in the right hip. Radiographs of the pelvis and both hips showed a normal hip on the left side, but the right hip showed advanced deformity of the capital epiphysis, which was flattened into a thin strip lying on the expanded neck (Fig. 3).

The contracture of the knee was corrected by traction and he was discharged after one month. He has since had two attacks of pain and swelling of the left knee.

Blood examination—Whole blood clotting time (Lee and White at 37 degrees Centigrade) was as follows: first tube, 9½ minutes; second tube, 18 minutes; third tube, over 30 minutes. Plasma clotting time was 12 minutes. Prothrombin activity was 62 per cent. Serum prothrombin time was as follows: after 4 hours, 14½ seconds; after 24 hours, 15 seconds. There were no other significant findings in his blood.

Case 3—The patient was an eighteen-months-old boy. He began to walk at the age of sixteen months and attention was drawn at once to his left hip by his gait. He had a limp with muscle spasm and limitation of abduction. Radiographs showed a small capital epiphysis on the left side (Fig. 4). He was admitted to hospital and, after an initial period of traction, a plaster spica was applied. Extensive bruising developed at the edges of the plaster, which was therefore removed. Extensions were reapplied for two months. When the traction was discontinued, spasm of the hip reappeared, he developed a swelling of the left knee, and after a trivial injury large haematomata developed over the forehead and knee. His bleeding time was 1 minute 30 seconds and coagulation

FIG. 6

FIG. 7

Case 4—Boy aged eight. Proven to have haemophilia. Haemarthrosis left hip at age of seven. Radiograph at that time showed no abnormality. Further haemarthrosis at age eight. Radiograph then showed broadening of the epiphysis and irregularity of the postero-superior aspect (Fig. 6). Figure 7 shows the condition one and a half years later.

time over 19 minutes. He developed a swelling of the left ankle and a large bruise over the left groin. These settled, but it was three years after his admission before he could be sent home. Radiographs taken at the age of fourteen years showed a short underdeveloped distorted neck, with the remains of the flattened epiphysis on the postero-superior aspect (Fig. 5).

Blood examination at the age of fifteen years showed the following findings: capillary clotting time 60 to 65 minutes (normal for method used 7 minutes); fibrin appearance time 35 to 40 minutes; prothrombin content 80 per cent; platelet count 306,900 per cubic millimetre.

Case 4—The patient was a male with a family history of haemophilia for four generations. His haemophilia was recognised when he was four years old when he was admitted to hospital with a haemarthrosis of the left knee. At the age of seven he was again admitted with a haemarthrosis of the left hip after a fall downstairs. Radiographs were normal. One year later he was admitted to the Royal National Orthopaedic Hospital with a further haemarthrosis of the left hip. Radiographic examination at this stage showed broadening of the epiphysis and irregularity of the postero-superior articular margin (Fig. 6). This appearance persisted in subsequent radiographs taken one and a half years later (Fig. 7).

FIG. 8

Case 5—Man of thirty with proven haemophilia. Three months' pain in right hip. Movements half normal. Note cystic changes in head. Articular surface is irregular over the cysts.

FIG. 9

Case 6—Boy aged six. Proven to have haemophilia. No symptoms referable to the hip. Clinically there was no restriction of hip movement. Note cyst in the epiphysis.

FIG. 10

Case 7—Man aged forty-seven. Proven to have haemophilia. Note cystic changes in the right femoral head and narrowing of the joint space. Little sclerosis. No osteophytes. In the left hip there is considerable deformity of the head and narrowing of the joint.

Case 5—A man aged thirty years gave a history of haemophilia affecting his maternal grandfather and one brother. He himself had been known to suffer from haemophilia from the age of two, since when he had intermittent haemarthrosis of the left knee and right elbow. When seen at the Bolton Orthopaedic Clinic he complained of pain and swelling of three months duration in the right hip. He had had no previous trouble with the hip, and no injuries. The range of movement in the hip was reduced by about half in all directions. Radiographs showed broadening of the neck and the epiphysis, with slight flattening of the latter. In the medial half of the metaphysis and the epiphysis cysts of varying size were present and there was irregularity of the articular surface (Fig. 8).

Case 6—A child aged two was admitted to Bolton Royal Infirmary with a history of having injured his upper lip. Bleeding was prolonged and he was an in-patient for nine days. Thereafter it was noticed that he tended to bruise easily. When three he was admitted suffering from prolonged epistaxis. He had intermittent swelling of the left elbow and right knee, and developed a flexion contracture of the right knee. He was referred to the orthopaedic department at this stage and underwent conservative correction of the contracture of the knee. The left elbow was a little thickened and had a range of movement from 160 degrees to 60 degrees. The right knee was thickened and had only a few degrees of flexion from a position of 140 degrees. There was no history of injury to the hips and he had no restriction of hip movement. His bleeding time was 2¼ minutes, and his coagulation time was 27 minutes. At the age of six, a radiograph showed a cyst in the epiphysis of the head of the femur on the right side (Fig. 9). There were no definite physical signs in the hip.

Case 7—A man aged forty-seven years had had recurrent haemorrhages since the age of twelve and had been a known haemophiliac from fourteen. Three nephews were affected, all sons of his sisters. He had one normal brother and his mother had four. He had had several haemorrhages into various joints, but he made no special complaint about either hip. He had required repeated blood transfusions after dental extractions when thirty-three. Radiographs of his right hip showed considerable narrowing of the joint space, with apparent cystic changes in the femoral head. The left femoral head was deformed, the joint space narrowed, and there were osteophytic outgrowths on the upper aspect of the joint (Fig. 10).

Blood examination showed the following findings. Blood coagulation time, at the age of thirty, was over 15 minutes; at the age of thirty-three, 10¼ minutes; and at the age of thirty-five, 8 minutes 10 seconds. Bleeding time was 3 minutes 15 seconds.

PATHOLOGY

In haemophiliac arthropathy the joint becomes distended with blood under pressure. The blood acts as an irritant, and hyperplasia of the synovial membrane occurs. Pigment and, later, connective tissue are laid down in the subsynovial tissues. At the same time, cartilage is eroded at the margins of the joint, and the central articular cartilage undergoes a variable amount of destruction. These changes were described by König (1892) and later by Key (1932). The changes in the cartilage were considered to be due to the blood in the joint and to subchondral haemorrhage. The characteristic change in the bone is the appearance of cavities, which may be deep in the cancellous bone, or shallow depressions in the bone underlying the articular cartilage. The bone cavitation was considered to be due to intra-osseous haemorrhage, although other workers (Freund 1925, Reinicke and Wohlwill 1929) postulated a chemical effect in addition to the mechanical effect of the extravasated blood.

More recently Ghormley and Clegg (1948) have described the condition of haemophiliac pseudo-tumour. This condition is characterised by the development of an enormous haematoma, the thigh being most frequently involved. The lesion is usually monostotic with some involvement of the most nearly adjacent joint. At post-mortem examination a large haematoma is found under the raised periosteum, and the underlying bone shows the varying amount of erosion and destruction. Ghormley and Clegg concluded that these pseudo-tumours may arise, first from haemorrhages in the joint, extending along the bone to produce pressure erosion; secondly from subperiosteal haemorrhages, which may at first lead to the formation of new bone, and later to absorption and destruction of bone; and thirdly

from cortical or medullary haemorrhages which may lead to cystic changes and later may destroy the bone or lead to fracture and further haemorrhage.

The characteristic result produces a radiographic appearance rather resembling that of pseudocoxalgia (Legg-Perthes' disease), a condition which, apart from haemophilia, usually appears to be due to any of several causes of a vascular disturbance leading to degenerative changes in the growing head of the femur (Zemansky and Lippmann 1929). Thus these or similar changes are sometimes seen in the hips of children with fractures of the neck of the femur, slipped epiphysis, and congenital dislocation of the hip, and have also been observed in achondroplasia, in juvenile rickets, in chondro-osteo-dystrophy (Morquio-Brailsford) and in sundry other rare diseases. Arkin and Schein (1948) draw attention to the occurrence of such aseptic necrosis of the head of the femur in lipoid granulomatosis (Gaucher's disease), which they believe to be caused by perivascular infiltration of the Gaucher cells, cutting off the blood supply to the head of the femur.

Interference with the blood supply of the head of the femur may also be caused by separation of the head from the neck by trauma, or perhaps by acute torsion reducing an already impaired blood supply. In congenital dislocation of the hip, pressure may be an additional factor. After reduction the shortened muscles are taut and considerable pressure may be exerted on the epiphysis as it is compressed against the acetabulum.

There are therefore two suggested mechanisms by which the femoral head may be deprived of blood: direct tearing of the blood vessels, or compression of the vascular channels.

DISCUSSION

The changes in the haemophiliac hip joint are of interest for three reasons. First, changes are produced which before puberty have some features similar to those observed in pseudocoxalgia, and after puberty have features similar to osteoarthritis. Secondly, the mechanism of production of these changes is interesting; and thirdly, these lesions may add to the understanding of the changes which take place in other disorders of the hip joint. The published case reports show that there is a marked difference between hip joints affected before and after puberty. The series of cases reported here represents a cross-section of the findings in the different age groups, and tends to confirm these views.

Changes before puberty—Before puberty the changes in the hip have features similar to those of pseudocoxalgia. In the series reviewed by Löhr (1930), there were six patients below the age of puberty. Four of them showed radiographic changes which are nearer to those found in pseudocoxalgia than are those in the present series, in that the epiphysis showed a slight flattening and patchy irregularity found in this condition. The present series suggests that not only is there a difference between hip joints affected before and after puberty, but that the changes in the hip joint differ in the different age groups. Each case in this series shows a varying degree of epiphysial damage. These appearances may be the result of haemorrhage of varying extent occurring at different ages, or it may be that with bearing weight the deformity of the head progresses.

The epiphysis least affected was that of a boy of six (Case 6) whose radiograph showed a single intra-epiphysial cyst. There is so far no flattening or irregularity of this epiphysis. In Case 4, a boy of eight, the epiphysis shows some broadening and irregularity, but no flattening. The changes developed within a period of one year as shown by the normal radiograph obtained one year before. A more severe degree of deformity was seen in Cases 1 and 2. In Case 2 there was a history of injury at the age of four, and in six years the epiphysis became compressed into a thin strip. In Case 1 there was considerable flattening of the epiphysis at the age of ten, and over a period of two and a half years there was further progressive flattening. In Case 3, which showed the most severely affected hip, the patient had a haemorrhage in the region of the hip at the age of eighteen months. One of the patients

reported by Montanari (1922) was a child of two, and it is interesting to note that the features of the case were almost identical with those of Case 3.

Mechanism of production of these changes—An attempt can now be made to correlate these findings with the pathology. It is evident that haemorrhage can occur into any part of the joint. It may occur into the joint cavity or into the bone, or may involve all parts of the joint. The changes which result depend not only on the age of the patient but also on the site and severity of the haemorrhage. There may also be a variation in the degree to which different structures are vulnerable, in addition to an individual susceptibility. The epiphysis and epiphysial cartilage are most susceptible to the effect of haemorrhage, and early damage will produce more severe deformity later, as in Case 3.

From a study of the radiographs and the reported pathological material it appears likely that the intra-osseous haemorrhages are of primary importance in producing the changes seen in bone and cartilage. The cystic changes in the epiphysis (Cases 4 and 6) and the broadening present in the diaphysis (Cases 1 and 2) may arise from haemorrhage in the epiphysis or diaphysis, or from an extension of the haemarthrosis. The severity of the epiphysial change (Cases 1, 2, 3, 4 and 6) suggests that intra-epiphysial haemorrhage is responsible for most of the epiphysial damage, though it takes weight-bearing to complete the collapse of the epiphysis and to produce severe deformity. With continued weight-bearing the epiphysial deformity increases.

Changes after puberty—In hip joints affected after puberty the radiographs show diverse changes. Some show deformity of the head suggestive of earlier damage, as in Case 7, whereas others show coxa valga or bone cyst formation or may have features similar to osteoarthritis, as in Cases 5 and 7. Previous publications demonstrate these points and draw attention to the similarity to osteoarthritis. The patients, however, are usually in a younger age group than in osteoarthritis, the radiographs show a more generalised osteoporosis, and cyst formation is more common. In Case 5 the radiographs showed well marked changes in a young man of thirty. The head of the femur was deformed from previous damage and cysts were present in the head and adjacent neck. Early arthritic changes were present. Case 7 shows arthritic changes in both hips with considerable deformity of the head on the left side and cyst formation on the right side.

Mechanism of production of changes after puberty—In patients affected after puberty the effects are not so severe. Haemorrhage into the head produces cyst formation without collapse, and intra-articular bleeding may produce no more than irregularity of the articular cartilage with narrowing of the joint space, changes which resemble those of any arthritic joint (Cases 5 and 7). If deformity of the head is present, it is likely that there was earlier epiphysial damage, and it seems unlikely that epiphysial damage of any severity could occur without later deformity.

Several of the published reports show that secondary changes in the joint need not follow an initial haemarthrosis, and even repeated haemorrhage may not lead to joint changes (Löhr 1930, Keefer and Myers 1933, McDonald and Lozner 1943, Newcomer 1939). Certainly a synovitis from haemorrhage need not produce permanent change, and Collins (1951) has shown that deposition of pigment in the subsynovial layer is unlikely to play a part in producing arthritic change. Although this has been demonstrated in haemophiliac arthritis of the knee and may apply to the hip joint, it is possible that in some published reports the haemorrhage has been extra-articular.

Pseudocoxalgia and haemophiliac arthropathy—The question may be raised as to whether the younger patients in this series were in fact examples of haemophilia with an incidental pseudocoxalgia. There are several points of difference which make this unlikely. The radiographic changes seen in Cases 1, 2 and 3 are not those seen in a typical pseudocoxalgia. There is much more flattening and destruction of the epiphysis and more broadening of the neck. No case shows the patchy irregularity seen in the typical pseudocoxalgia, and even

allowing for the fact that all the patients had been bearing weight, no case of haemophiliac arthropathy shows any attempt at reconstitution of the head of the femur. These cases are therefore different from pseudocoxalgia. It may be that the essential difference is in the site of the haemorrhage. Radiographs in pseudocoxalgia show metaphysial cysts, which could be due to metaphysial haemorrhage, but in haemophiliac arthropathy the cysts and probably the haemorrhage are mainly intra-epiphysial, and the compression of the epiphysis is responsible for the more uniform increase in density which results.

SUMMARY

1. Seven cases of haemophiliac arthropathy of the hip joint are reported.
2. Attention is drawn to the different appearances in the hip when it is affected before and after puberty. Before puberty there are features similar to pseudocoxalgia. After puberty there may be cyst formation, coxa valga, or features similar to osteoarthritis.
3. It is suggested that intra-osseous haemorrhage is important in the production of these changes and that intra-epiphysial haemorrhage is responsible for the appearances seen before puberty.

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ROTATIONAL LORDOSIS: THE DEVELOPMENT OF THE SINGLE CURVE

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A review of the literature on curvature of the spine—with particular reference to the deformity that has come to be called scoliosis—cannot but fill the reader with a sense of frustration. Despite the recording of a mass of evidence—much of it conflicting—and the presentation of many different explanations, the commonest form of the deformity is still rightly called "idiopathic." The problem is clearly one that should not be approached lightly, and it is with some trepidation that a further hypothesis is suggested in a paper which at present can be little more than a preliminary report.

A hundred years ago scoliosis was much discussed, and Sir William Adams, in his lectures published in 1864, summed up the more authoritative views of the time when he said that: "Rotation plus lordosis equals lateral flexion"; but the inference throughout was that rotation was the primary factor. It seems more logical and less misleading to describe deformities of the spine in relation to the spine itself as a unit rather than to describe them in relation to the body as a whole. To describe rotation plus lordosis as a scoliosis can be nothing but misleading, for scoliosis is defined as lateral flexion of the *spine*. This then is my excuse for suggesting a new concept and a new name for an old disease.

FIG. 1
Typical "structural scoliosis."

The deformity—Figure 1 shows a spine with a considerable curvature of the type commonly called structural scoliosis. If we examine the curve critically we see that at the apex the vertebrae are almost in lateral view, with their bodies on the convexity and the neural arches in the concavity. This curve is therefore a lordosis. That rotation is present is obvious. Unfortunately the deformity is not quite so simple as this. In the early stages, when only minimal deformity is present, the lateral view shows a small but definite mid-thoracic lordosis (Fig. 2). As rotation increases the spine becomes flattened (Fig. 3). Later an apparent kyphosis develops (Fig. 4), and increases (Fig. 5). By this time there is 70 degrees or more of rotation, so that what is seen as kyphosis is in fact lateral flexion of the spine. Analysed, the deformity consists of lordosis, rotation and lateral flexion. It is the purpose of this paper to describe a mechanism by which such a deformity may develop and to indicate some ways in which the local mechanics may influence the final curve.

FIG. 2

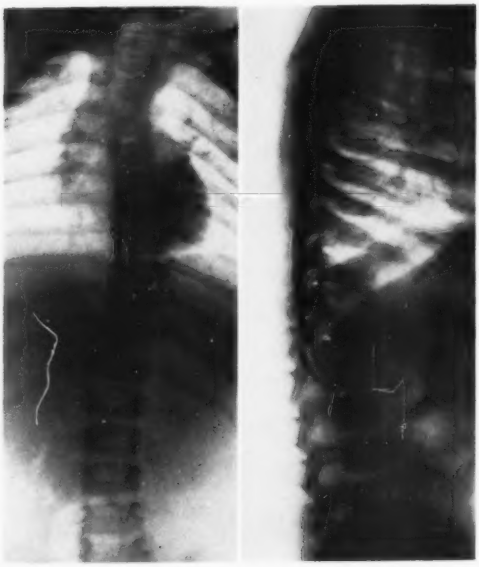

FIG. 3

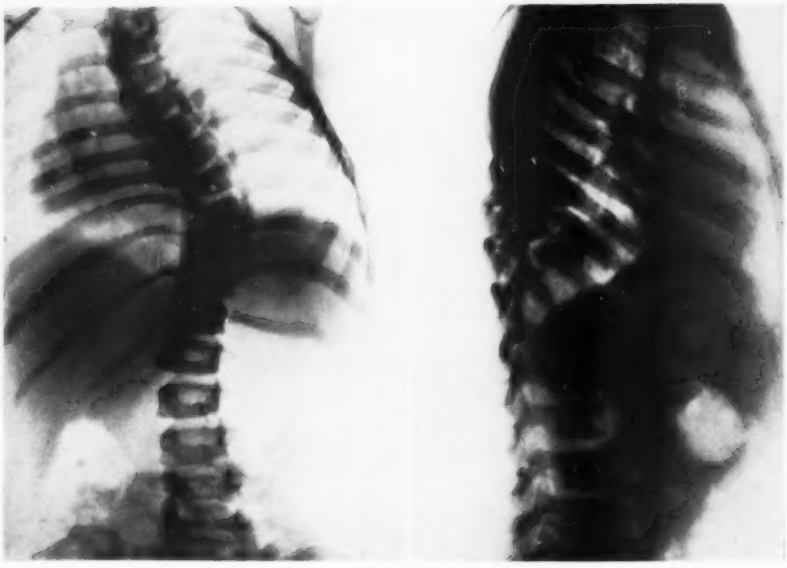

FIG. 4

Stages in the progressive development of the deformity.

PRODUCTION OF THE DEFORMITY

The primary mechanism—It is probably easier to appreciate the deformity if the sequence of its development is studied.

Lordosis—The simplest way in which a localised structural lordosis could develop would be by a failure of growth of the posterior elements of the vertebrae (by this is meant all that part of a vertebra lying behind the body). If this were to happen to an exaggerated extent it would be possible for a localised lordosis of 90 degrees or more to develop. This is a deformity that we seldom recognise because, as it develops, compensatory changes occur in the spine and the original deformity is rapidly obscured.

Compensation—To compensate a slowly developing structural lordosis the spine is flexed forwards. At first a small kyphos develops above and below (Fig. 3). But soon it is impossible for further forward flexion to occur without bone changes developing and it is easier for

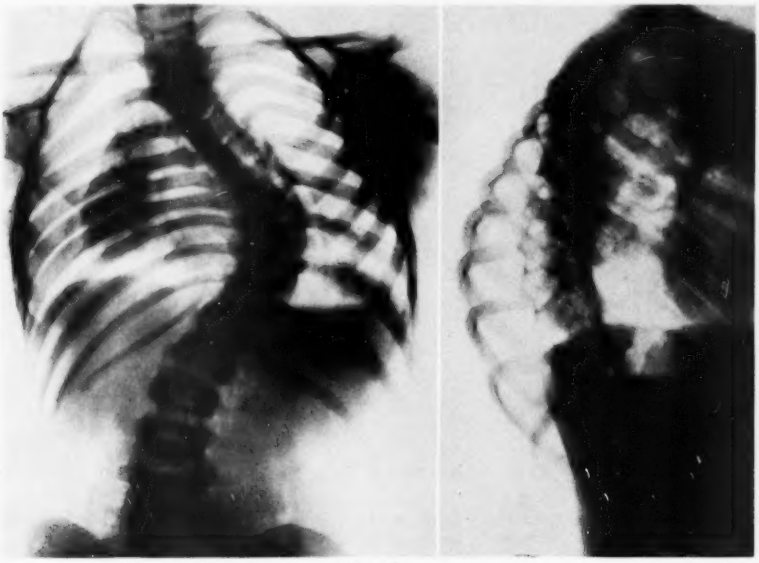

FIG. 5
The fully established deformity.

the affected area of the spine to rotate instead; then simple lateral flexion of the normal parts of the spine above and below will bring the head once more above the pelvis and result in an appearance very like that seen in Figure 1.

Rotation—It is easier to demonstrate the mechanism of this than to describe it. Figure 6 shows a model which represents a spine. The vertebral bodies are represented by wood blocks separated by "intervertebral discs" of sponge rubber. Hooks in the backs of the "vertebral bodies" represent the posterior elements, and these are joined together in such a way that the upper and lower parts are relatively straight but in the middle they are joined more tightly so that there is a small "lordosis." For the purposes of the experiment we must assume that the lordosis has already developed. If the model is flexed forwards in an attempt to overcome the lordosis, at first a kyphosis develops above and below, and then the affected area begins to rotate (Fig. 7). The more it is flexed the more it rotates, and if the two ends are approximated to represent the effect of gravity the rotation is still further increased (Fig. 8). Distraction produces the reverse effect.

Assessment of rotation—It is of value to be able to make an estimate of the degree of rotation of the vertebrae involved in a curve. This may be done by making a standard for comparison by radiographing a vertebra in different positions of rotation. This sometimes shows a remarkable degree of rotation between two adjacent vertebrae. For example, a study of the radiograph shown in Figure 1 indicates that T.12 is rotated at least 60 degrees, whereas L.1 is rotated only 10 degrees.

Lateral flexion—It is not intended here to discuss the mechanics of the different parts of the spine: suffice it to say that rotation is easy at first but meets with increasing resistance which entails moulding of bone. On the other hand, as rotation increases lateral flexion of the spine itself (that is, forward flexion in relation to the body) meets with less resistance so that a point is reached at which the resistance to each is the same. From this point onwards considerable pressure is applied to one side of the vertebrae. At first this is absorbed by the

FIG. 6

FIG. 7

FIG. 8

Figure 6—The model shows the localised fixed lordosis. Figure 7—Rotation produced by forward flexion. Figure 8—Rotation increased by compression such as might resemble that due to gravity.

resilience of the intervertebral discs, but soon the pressure falls on the soft growing bone of the vertebral bodies so that their growth on one side is depressed and they become wedged, with further increase of the deformity.

The secondary mechanism—There is one other factor which should be added to the above mechanism. After a certain amount of lordosis has developed the posterior articulations rapidly lose their flexibility and become increasingly rigid. We then have a " spine " in which the posterior elements will not bend and do not grow. If under these circumstances the vertebral bodies continue to grow they can only do so by being displaced laterally, that is, by increasing the degree of rotation. It is not always possible to say just how much each of these mechanisms plays a part in the production of any one curve, but it seems probable that both are in operation at the same time, the former decreasing in influence, the latter increasing.

AN EXPERIMENTAL STUDY

So far I have given only a theoretical concept of the way in which this deformity may develop. In an experimental study on young rabbits, an attempt was made to prevent growth

of the neural arch by cauterisation of the laminae on each side of the spinous processes. In the first experiments this did not cause a recognisable deformity because the posterior ligaments were destroyed and the laminae and facets merely separated as the bodies grew. The ligaments were therefore reinforced by wire loops lightly placed round the spinous processes before the laminae were burned. In the three surviving rabbits in which the operation was done on four adjacent vertebrae a curve has developed which closely resembles that seen in man, including rotation and deformity of the ribs (Figs. 9 to 13). Deformity was first noticed three weeks after operation.

Three points about these specimens should be mentioned. 1) Much experimental work has been done by others in an attempt to produce curvature of the spine. Usually these experiments have been based on attempts to arrest growth in one side of adjacent vertebral bodies. This has resulted in simple lateral flexion of the spine but, as far as can be judged from examination of the illustrations, there has been little or no rotation. In our experiments considerable

FIG. 9 FIG. 10 FIG. 11 FIG. 12

Development of a thoracic curve produced artificially in a rabbit. Serial radiographs taken at five-weekly intervals.

rotational deformity developed. 2) The deformity in our experiments has been produced in an animal in which it is unknown in nature and in which gravity can play no part. 3) All the curves have gone to the right although every effort was made to apply heat equally to both sides. The number is, of course, small and this may be coincidence.

When three vertebrae were operated on the curve developed much more slowly, and was not visible before seven weeks from the date of operation in the only rabbit which survived long enough. When one or two vertebrae have been treated and the animal has survived, no curve has been produced so far. But it is too soon to draw conclusions, and a curve may yet be produced by operating upon a smaller number of vertebrae. It must be remembered that experiments such as those described are very rough compared with the refinements of nature.

Controls have been done which cover some of the possible errors. 1) The laminae have been burnt, without wiring of the spinous processes. 2) The spinous processes have been wired together, without burning the laminae. 3) The muscles on both sides have been stripped from the laminae and lightly burnt. 4) The muscles on one side only have been stripped from the laminae. In none of these animals has any curve resulted.

FACTORS AFFECTING THE TYPE OF CURVE

There are two chief factors which will determine the type of curve, namely, different mechanics in different parts of the spine, and variations in the extent of growth changes.

Mechanics of the spine—The relevant part of the spine is divided anatomically into two sections. In the thoracic spine the articular facets lie on a circle, the centre of which is within or just in front of the intervertebral disc, so rotation is free. In the lumbar spine the articular facets lie on a circle whose centre is posterior to the facets; consequently rotation is possible only to the limit of the looseness of the ligaments and to the amount that one vertebral body can be displaced laterally on its neighbours. This allows only a few degrees of movement without stretching of ligaments or moulding of bone. The other important difference between the two segments is the attachment of the ribs to the thoracic vertebrae. The ribs do not seriously affect the mechanics of normal rotation, but localised

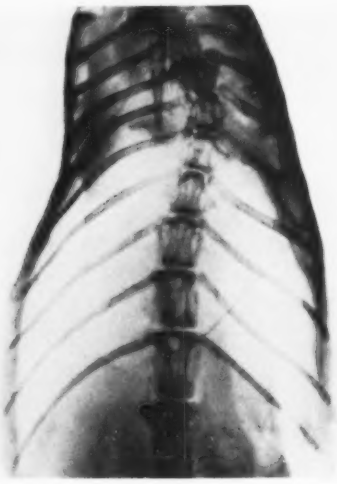

FIG. 13

Radiograph of the spine of another rabbit taken post-mortem.

FIG. 14

Lumbar scoliosis in which subluxation of the vertebral bodies gradually occurred.

rotation can occur only if the ribs are moulded, often to an extreme degree. Thus rotation in the thoracic spine is restricted by the ribs, and in the lumbar spine by the shape and position of the articular facets. This difference of rotation exerts the greatest influence on the character of the ultimate curve. In rotational lordosis of the spine rotation is produced by considerable force applied to the spine in an attempt to compensate the lordosis. If this force is applied to regions of a spine in which different mechanics exist, the same forces will produce different curves in the different segments. For example, we find that a thoracic curve is quite unlike a lumbar curve. In the thoracic region the structural changes that occur are either in the ribs or in the vertebral bodies rather than in joints, so that deformity is severe and pain slight. In the lumbar spine the reverse is the case. Extensive rotation can take place only by subluxation of one vertebral body on the next (Fig. 14) and by subluxation and moulding of the articular processes; deformity is less severe but pain is a noticeable feature.

Variations in the growth defect—There is no certain way of determining how many vertebrae are primarily involved, but examination of many radiographs suggests that the

number may vary considerably. The appearances also suggest that all the vertebrae primarily affected may not be involved to an equal extent. Thus there are many possible variations, about which our knowledge is at present scanty, but which may play a big part in decompensation.

DISCUSSION

A hypothesis has been presented that a complex deformity consisting of lordosis, rotation and lateral flexion—which by custom is called structural scoliosis—is the result of a chain of events initiated by a structural lordosis arising from failure of growth of the posterior elements of a segment of the spine. There is no difficulty in postulating this hypothesis in certain congenital abnormalities, nor in the complicated curves of cretins with their patchy growth disturbance, and for a long time it has been appreciated that growth plays an important part in the development of idiopathic structural scoliosis, though we may not know the cause of the growth disturbance. But we find the most excellent examples of this deformity in certain cases of anterior poliomyelitis. Deformity after poliomyelitis is usually attributed to muscle imbalance, but it may be difficult to say where the imbalance lies and sometimes the curve seems to go in an unexpected direction! There are many similarities between the curve in anterior poliomyelitis and the curve found in such conditions as idiopathic structural scoliosis, and the only real difference is that the curve in poliomyelitis is usually longer. A feature of poliomyelitis is the way in which the growth of a bone closely associated with paralysed muscles may be interfered with to a greater or lesser extent for a longer or shorter time. In the relevant area of the spine the only part of the vertebrae to which muscles have important attachments are the various parts of the neural arch, and if its growth were disturbed as a result of paralysis of the sacrospinalis muscle a rotational lordosis would result. It has been mentioned already that a variable number of vertebrae may be primarily involved and it seems unlikely that in poliomyelitis less than five or six would be affected, and often many more. This would result in a long curve. In the idiopathic deformity it is more likely that a smaller number of vertebrae are involved, resulting in a tighter, shorter and more vicious-looking deformity.

SUMMARY AND CONCLUSIONS

This paper is a theoretical and experimental study of the processes involved in the development of curvature of the spine which we have come to call scoliosis. Reasons are advanced why the term scoliosis in its modern meaning may be misleading and an alternative title of Rotational Lordosis is suggested. It is admitted that it is more cumbersome, but I maintain that it is more accurately descriptive of the deformity under discussion and differentiates it from other curvatures which are produced differently but at present all of which come under the heading of scoliosis. I am conscious that many gaps still remain unfilled, especially the important but unexplained problem of the nature of the growth disturbance. If we could solve this we would be near to a solution of one of the most bizarre, mysterious and crippling deformities with which we are faced.

I wish to thank my colleagues at the Nuffield Orthopaedic Centre for their help. I am especially grateful to Professor J. Trueta for placing at my disposal facilities for carrying out the experiments and for much helpful advice whenever needed, and to Mr J. C. Scott for access to his extensively documented and illustrated cases collected and analysed over many years.

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EXPERIENCES WITH BOILED CADAVERIC BONE

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Boiled bone—homogenous and heterogenous—as material for grafting has, in the past, received considerable attention, but earlier results did not appear to justify further trials, and fresh autogenous transplants superseded boiled grafts almost entirely. Boiled cadaveric bone was regarded as less reliable than autogenous bone, slow to become incorporated into the host, and not altogether free from the suspicion that foreign proteins might carry their own peculiar dangers. Hey Groves (1917), however, advocated it if bone pegs were to be used and if the supply of fresh autogenous bone was scanty or the removal of a suitable graft was contra-indicated. "Os purum" (Orell 1938) was sterilized by boiling in saline.

Reviewing the experiences of previous workers we found that many of the failures may have been due to technical errors. The modern principles of careful preparation of the bed so as to obtain a large area of vascular host bone in contact with the graft, absence of bending stress and firm apposition of the graft to its bed by precise joinery or efficient internal fixation, were not well established, and in consequence failures with any type of graft were common.

If it is assumed that cortical bone grafts become incorporated by a process of invasion by the host and that the graft does not survive in its transplanted state, it is difficult to understand why boiled bone should not be a useful addition to the bone bank. Furthermore, a far from unique case of our own in which a graft cut from the tibia was contaminated and had to be boiled before its transfer to the radius illustrated that fusion follows without undue delay. Recent experimental evidence (Reynolds and Oliver 1950, Odell, Mueller and Key 1951) indicates, however, that boiled bone, although capable of carrying out the functions of a fresh or frozen graft, does so more slowly—findings which conflict with those of Hey Groves (1917), who was unable to show any difference in behaviour between boiled and fresh bone transplants. On the basis of these considerations, and stimulated by the experiences of others with stored homogenous bone, which demonstrated that foreign protein reactions do not exist as a practical problem even in unboiled bone, we resolved to resurrect in our practice the use of boiled cadaveric bone—tentatively at first, but later, as our knowledge grew, with greater confidence.

PREPARATION AND STORAGE

The bone is obtained at necropsy from the tibia and ilium, and soft tissue is scraped away. The bone is boiled for half an hour, cut into convenient lengths of the tibia or blocks of the ilium, and stored dry in a household refrigerator. Before use it is boiled again for twenty minutes. This method has the virtue of simplicity, and it does not require elaborate methods of asepsis or bacteriological control. Needless to say, the source is infinite.

RESULTS

In earlier cases we limited ourselves to replacing tibial and iliac defects remaining after autogenous grafts had been taken (Fig. 1). Since there was no untoward reaction, we then applied boiled grafts to long bones when undertaking open reduction and internal fixation of fractures, using the bone in addition to the necessary metallic fixation. We learnt from these cases that the grafts served in the same way as fresh autogenous grafts; the risk of sepsis did not seem to be increased, and there was no tendency for the grafts to be rejected as foreign bodies.

FIG. 1

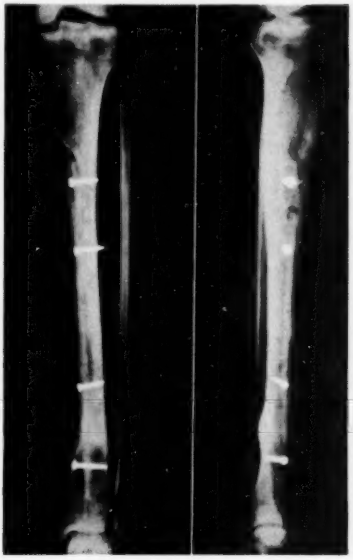

FIG. 2

Figure 1—Reconstruction of a tibial defect by means of a cadaveric graft. Autogenous bone had been removed for spinal fusion. Figure 2—Bone graft for ununited fracture of tibia. The fracture occurred after removal of tibial bone for spinal fusion. The massive cadaveric graft was inlaid into the defect and across the fracture in the manner of a sliding graft.

FIG. 3

FIG. 4

Figure 3—Twin onlay bone grafts for ununited fracture of the humerus. Figure 4—Arthrodesis of tuberculous elbow by crossed cadaveric grafts. Sound fusion was secured in four months despite the sacrifice of bone to a previous unsuccessful arthroplasty.

FIG. 5

Ischio-femoral arthrodesis of the hip for poliomyelitis. The cadaveric graft was used four months after an intra-articular operation because union was progressing very slowly. Fusion followed rapidly.

FIG. 6

Arthrodesis of wrist by a cadaveric iliac graft applied to the dorsal surface.

Our experience now extends over two years and includes 112 bone-grafting operations. In fifty-five of these cases cadaveric bone was used in the spine, often in association with autogenous bone (these cases are to be reported after a three-year follow-up). There remain thirty-four cases that have been under observation for more than one year after grafting, and these form the subject of this report. The types of operation and the results are summarised in Table I, and illustrative radiographs are shown in Figures 1 to 8. It will be seen that of the thirty-four cases, fusion of the graft has been observed in twenty-six. Eight, however, have failed, and these merit further consideration and an attempt at explanation.

In three cases failure can be attributed to errors of technique. In a case of arthrodesis of the wrist by Brittain's method too much was expected of the graft, which was found, in

TABLE I

RESULTS IN THIRTY-FOUR CASES OF BONE GRAFTING WITH BOILED CADAVERIC BONE

Operation	Number of cases	Successes	Failures
Arthrodesis of hip	10	8	2
Arthrodesis of shoulder	2	1	1
Arthrodesis of wrist	4	3	1
Arthrodesis of knee	2	2	—
Arthrodesis of elbow	2	1	1
Nail and graft for fractured neck of femur	3	2	1
Bone graft for ununited fracture of radius	2	2	—
Bone graft for ununited fracture of tibia	1	1	—
Bone graft for ununited fracture of femur	2	1	1
Bone graft for ununited fracture of humerus	1	1	—
Filling of bone cavities	5	4	1
Totals	34	26	8

the post-operative radiograph, to be lying away from its bed and was thus unprotected from stress. In the second case nailing and grafting a four-weeks-old transcervical fracture of the neck of the femur was attempted, the displacement was accepted, non-union has occurred and the graft has broken. In the third case, chip grafts were extruded from a chronic osteomyelitic cavity which had been incompletely packed so that a residual pocket was left.

An arthrodesis of a tuberculous elbow failed because it was ill-timed. Attempts to bridge a gap were unsuccessful in two cases of extra-articular ischio-femoral arthrodesis without osteotomy, and in one of scapulo-humeral arthrodesis—severe tests of any graft. The remaining failure followed grafting for ununited fracture of the femur in a case of osteogenesis imperfecta. Here the fragility of the bone, coupled with the deformity produced by previous nearby fractures, made efficient joinery impossible.

It will be noted that if we exclude the case of osteogenesis imperfecta all our failures were in technique, in timing, or in attempting to make an unsupported cadaveric graft span a wide gap.

DISCUSSION

There was no sepsis in the group of cases reviewed, except in one case of failed cancellous chip grafting in chronic osteomyelitis. The four successful cases of chip grafting of bone cavities include the obliteration of two Brodie's abscesses, one tuberculous cavity in the

tibia (all with sinuses) and the reconstruction of a metacarpal bone after excision of a chondroma (Figs. 7 and 8). This simple procedure has the advantage that little harm is done if the grafts should prove unsuccessful.

It remains only to consider the comparative time factors involved. It has been said that boiled grafts are slow to unite, and some experimental evidence tends to support this view. We have, however, seen union in old fracture of the humerus (Fig. 3) and of the radius three months after grafting. Arthrodesis of the wrist (Fig. 6) has been sound enough to dispense with plaster after a similar interval. It is not possible to assess accurately the time taken for chip grafts to fuse, but we feel that they are not long delayed in comparison

FIG. 7

FIG. 8

Figure 7—Chondroma of fifth metacarpal before operation. Figure 8—After chip grafting with cadaveric bone.

with autogenous chips. In so small a series no useful comparison can be made between boiled homogenous and fresh autogenous transplants—neither conforms to a sufficiently reliable time-table. We can only say that our impression is that boiled bone is not significantly slower in becoming incorporated.

We consider that cadaveric bone grafting is worthy of further trial on the basis of the experience that we have described. We believe that boiled bone may be used with confidence when a bone graft is required for non-union of a fracture, to supplement an intra-articular arthrodesis, or to obliterate a bone cavity or surgically produced bone defect. Its capacity to bridge a gap cannot at present be assessed. However, as Wilson (1951) has pointed out, the possession of a bone bank brings with it a far greater application for bone grafting and if the bank is easily replenished and maintained further opportunities for its use will be found.

It gives me pleasure to thank Mr B. H. Burns and Mr R. H. Young, under whose care these patients were treated.

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ABDUCTION ARTHRODESIS OF THE HIP

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When visiting the orthopaedic department of the London Hospital in 1947 one of us was introduced to a method of arthrodesis of the hip joint, sometimes used in difficult cases by Watson-Jones and Osmond-Clarke, which is little known and may not have been recorded in the literature. In one patient with an ununited fracture of the femoral neck the avascular head was excised and the upper part of the greater trochanter, with the stump of the neck, was freshened and placed in the rawed acetabulum with the limb in 45 degrees of abduction, the femur being divided at a lower level after three weeks so that the shaft could be adducted to the neutral position. The same procedure of securing fusion by fixing the limb in wide abduction after denuding the articular surfaces, and later correcting the excessive abduction by osteotomy, had been used by Watson-Jones in congenital dislocations where apposition between the femoral head and pelvis could be achieved only in the widely abducted position, and by Osmond-Clarke in some cases of tuberculosis of the hip when there had been extensive destruction of the femoral head and neck.

During the last four years the writers have found this operation of considerable value in a number of conditions affecting the hip joint. They believe that the procedure will prove of value in all parts of the world and more especially in Africa and other countries where patients often delay many months before seeking medical aid.

Indications—The operation is worth considering in the following conditions: 1) ununited fracture of the femoral neck in younger patients; 2) certain cases of septic arthritis of the hip which have not responded to chemotherapy, immobilisation or minor exploratory operations; or in which the head and neck of the femur have been destroyed; 3) tuberculosis of the hip with discharging sinuses which have not responded to more conservative methods of treatment; 4) quiescent tuberculosis when the femoral head and neck are eroded to such an extent that other methods of arthrodesis are rendered difficult; or 5) old unreduced dislocation of the hip when it proves impossible to reduce the dislocation at operation before proceeding to fuse the joint.

TECHNIQUE OF OPERATION

First stage—With the patient on an orthopaedic table, the hip joint is exposed through an anterior Smith-Petersen incision, the rectus femoris being retracted medially or laterally as desired. After removing the head, or head and neck, of the femur, sequestra, diseased bone or infected granulation tissue, the acetabulum and greater trochanter are rawed with gouge and chisel. The limb is then abducted 45 degrees and the upper end of the shaft of the femur is placed in the acetabulum. In some cases this manoeuvre is facilitated by first placing a chisel in the upper part of the acetabulum and using it to lever the upper end of the shaft into position while the limb is slowly abducted. Bone chips cut from the anterior part of the iliac crest are used to fill the remaining space in the acetabulum. After closure of the wound a double plaster hip spica is applied with the limb still in abduction.

Second stage—The second stage of the operation is undertaken three to four weeks later. With the patient on an orthopaedic table a circular cuff of plaster is removed, of sufficient extent to expose the upper third of the femur. Through a lateral incision the femur is divided about two inches below its upper end. The leg is adducted to lie between the neutral position and 5 degrees of abduction. The wound is closed and the hip spica is completed.

Post-operative treatment—In all patients with infected sinuses penicillin is given twice a day

for about three weeks. After three months the plaster is removed and if clinical and radiographic examination show firm fusion of the hip and union of the osteotomy the patient is allowed up.

RESULTS

Of sixteen patients operated on in the last four years one died after the operation. In this case a modified operation had been done as a life saving measure. In fourteen patients firm fusion was obtained, with complete healing of sinuses when present. The remaining patient had had two previous operations and it was not possible to fit the greater trochanter firmly into the acetabulum; fibrous ankylosis only was obtained. Of four other cases not included in this series because the case records are not available, one died from tuberculous pyonephritis five days after operation.

CASE REPORTS

Case 1. *Ununited fracture of femoral neck*—A man aged forty years was admitted with a history of injury to the hip three months previously. Radiographs showed non-union of a femoral neck fracture with avascular necrosis of the head and upward displacement of the shaft of the femur (Fig. 4). The first stage of abduction arthrodesis was carried out in January 1951. Osteotomy of

FIG. 1 FIG. 2 FIG. 3

Diagrams to illustrate the principle of the operation. Figure 1—Before operation; absorption of head and neck of femur. Figure 2—After first-stage operation. Figure 3—After second-stage operation.

the femoral shaft was undertaken one month later. Three months later both hip and osteotomy were firm (Fig. 5). The patient had one and a half inches of shortening which was corrected by building up the shoe.

Case 2. *Osteomyelitis involving the femoral head*—A girl aged eight years was admitted with osteomyelitis of the whole femoral shaft. There was a pathological dislocation of the hip with a fracture-dislocation of the capital epiphysis; the head was sequestrated (Fig. 6). A sinus was present on the lateral aspect of the thigh four inches above the knee joint. This healed after a small exploratory operation and prolonged chemotherapy. The first stage of abduction arthrodesis was carried out in June 1950 and the second stage one month later. Three months later both hip and osteotomy were firm. One year later the patient was in excellent health and is walking well with a two-inch lift to the shoe.

Case 3. *Septic arthritis of hip*—A girl aged fifteen years was admitted with a discharging sinus over the hip. Radiographs showed complete destruction of the head and neck of the femur (Fig. 8). Exploration of the sinus and subsequent chemotherapy failed to bring about healing of the sinus. The first stage of abduction arthrodesis was done in May 1948. Owing to insufficient abduction the upper end of the femur slipped out of the acetabulum. It was replaced at a second operation. The second-stage operation was carried out one month later. Three months later the hip was firmly fused and the sinus healed (Fig. 9). Three inches of shortening was corrected by a patten on the shoe. The patient returned the following year with a soft-tissue swelling on the front of the thigh just below the groin; at operation a few small sequestra were removed. Healing occurred and there has been no recrudescence of the infection.

FIG. 4

FIG. 5

Case 1. Figure 4—Before operation. Figure 5—Three months after second-stage operation.

FIG. 6

FIG. 7

Case 2. Figure 6—Before operation. Note pathological dislocation with sequestration of femoral head. Figure 7—One year after abduction arthrodesis.

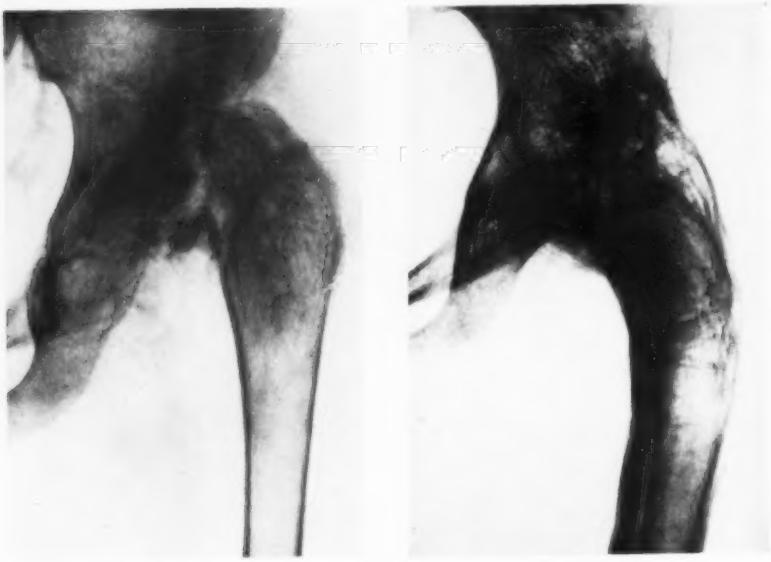

FIG. 8 FIG. 9

Case 3. Figure 8—Before operation. Destruction of head and neck of femur after septic arthritis. Figure 9—Three months after second-stage operation.

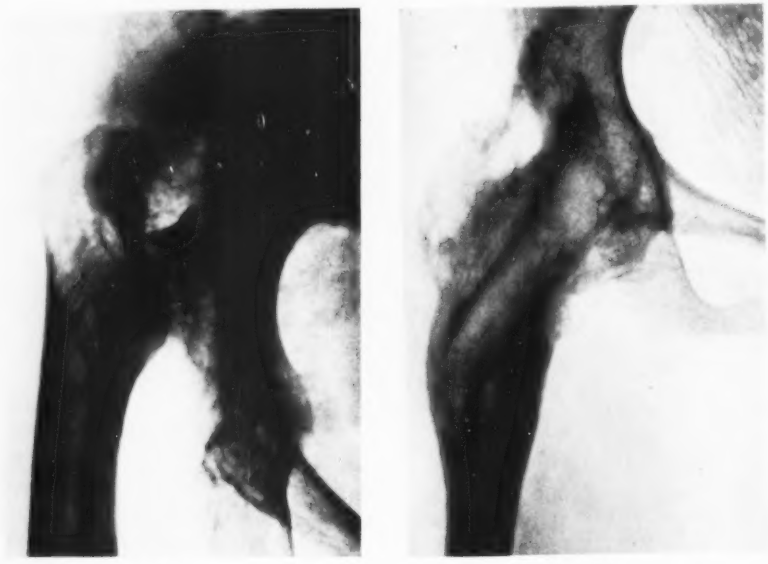

FIG. 10 FIG. 11

Case 5. Figure 10—Before operation. Figure 11—Three months after second-stage operation.

Case 4. *Tuberculous hip with infected sinuses*—A girl aged fourteen years was admitted with tuberculosis of the right hip. Ilio-femoral arthrodesis was performed after a period of rest, but four months later the wound broke down in two places. Repeated exploration with removal of numerous small sequestra failed to heal the sinuses. One year after the initial operation the first stage of abduction arthrodesis was undertaken and was followed by osteotomy three months later. Within six months the sinuses were completely healed and the hip firmly fused. One year later her general condition was excellent, the wound completely healed and the hip firm. Five inches of shortening was corrected by a patten.

Case 5. *Healed septic arthritis of hip*—A woman aged twenty years was admitted with a history of septic arthritis of the hip in childhood; she complained of pain in the hip with instability. Radiographs showed absence of the femoral head and neck with upward displacement of the greater trochanter (Fig. 10). Abduction arthrodesis was undertaken in two stages. Three months later the hip was firmly fused and the osteotomy united (Fig. 11). When last seen nine months afterwards she was walking well with a raised shoe.

Case 6. *Quiescent tuberculosis with erosion of head and neck of the femur*—A boy aged thirteen years was admitted with a history of tuberculosis of chest, spine and right hip of eighteen months duration, during which time he had undergone continuous conservative treatment elsewhere. Examination on admission showed advanced healing of the lesions in the lung and spine but there were three discharging sinuses round the hip. These healed completely after a six-week course of streptomycin. Radiographs at this time showed absorption of the femoral head and neck. Abduction arthrodesis was carried out in two stages. Three months later the hip and osteotomy were firm. One and a half inches of shortening was corrected by building up the shoe. He was discharged one month later walking well with one stick.

Case 7. *Unreduced dislocation of the hip*—A boy aged sixteen years was admitted with an unreduced pathological dislocation of the right hip which occurred during an attack of cerebrospinal meningitis eighteen months previously. Open reduction was attempted soon after his admission but it proved impossible to reduce the femoral head into the acetabulum. The first stage of abduction arthrodesis was therefore undertaken and was followed by osteotomy four weeks later. After four months both hip and osteotomy site appeared to be firm, and the patient was allowed up. But after a further two months the osteotomy site refractured and a hip spica plaster was therefore applied for a further three months. At the end of this time the fracture was firmly united. Three-quarters of an inch of shortening was corrected by building up the shoe and he was discharged one month later walking well with the aid of a stick.

Case 8. *Ununited fracture of femoral neck*—A woman aged fifty years was admitted with an ununited fracture of the femoral neck. At operation the femoral head was removed and the first stage of abduction arthrodesis carried out. Osteotomy of the femur was done three weeks later. After four months the osteotomy was not yet united and a further plaster spica was applied. Six months after operation the arthrodesis was firm and the osteotomy united. She walked well with sticks; one and a half inches of shortening was corrected by a raised shoe.

Case 9. *Osteomyelitis of neck of femur*—A boy aged nine years was admitted with osteomyelitis of the neck of the left femur. His right leg had been amputated below the knee for osteomyelitis of the tibia. Radiographs showed marked destruction of the femoral head and neck. There were no sinuses. After a prolonged course of chemotherapy operation was undertaken. The remnants of the head and neck were removed and the greater trochanter was placed in the acetabulum, the limb being abducted 45 degrees. Osteotomy of the shaft was done two and a half months later. Four months after the second stage the hip was firm and the osteotomy united. He walked well with crutches. He has not yet reported for fitting of an artificial limb.

Case 10. *Osteomyelitis of neck of femur*—A boy aged thirteen years was admitted with acute osteomyelitis of the right femoral neck. In spite of immobilisation and prolonged chemotherapy his condition slowly deteriorated. Radiographs four months after admission showed that the femoral head had sequestrated. At operation the sequestrum was removed and the acetabulum cleared of granulation tissue. The greater trochanter was rawed and placed in the acetabulum with the limb abducted 45 degrees. A plaster spica was applied. At the end of the operation his condition was fair, but he collapsed and died suddenly three hours later.

Case 11. *Osteomyelitis of neck of femur*—A girl aged six years was admitted with quiescent osteomyelitis of the neck of the right femur, of the left scapula and of the left side of the mandible. Radiographs showed marked destruction of the head and neck of the femur (Fig. 12). There was a 45-degree flexion contracture of the hip. Abduction arthrodesis was carried out in two stages. Three months later both hip and osteotomy were firm (Fig. 13). She left hospital walking well, with one and a half inches of shortening. Recently a stapling operation has been done on the left lower femoral epiphysis.

FIG. 12

FIG. 13

Case 11. Figure 12—Before operation. Figure 13—Three months after abduction arthrodesis.

FIG. 14

FIG. 15

Case 13.—Long-standing tuberculous arthritis of hip. Figure 14—Before operation. Figure 15—Four months after operation, shortly before removal of plaster. The operation was unsuccessful in securing bony fusion.

Case 12. *Osteomyelitis of upper end of right femur*—A girl aged sixteen years was admitted with quiescent osteomyelitis of the upper end of the femur, causing almost complete destruction of the head and neck. Abduction arthrodesis was carried out in two stages. Within three months there was sound fusion of the hip and union of the osteotomy. She was discharged from hospital with a raised shoe to correct two inches of shortening.

Case 13. *Tuberculosis of hip with infected sinus*—A girl aged nineteen years was admitted with a discharging sinus and marked soft tissue swelling over the left greater trochanter. She had had intermittent treatment for the hip over a period of five years, including prolonged conservative treatment and two operations of the Brittain type in an attempt to fuse the joint (Fig. 14). On admission the hip was immobilised and she was given a three-month course of streptomycin. At the end of this time the sinus was completely healed and her general condition was good. At the first stage of abduction arthrodesis it was not possible to obtain a firm fit of the trochanter in the acetabulum because of the gross destruction of the head and neck and two previous operations. Four weeks after the first operation the femur was manipulated into a position of 20 degrees abduction (Fig. 15). Three months later, when the plaster was removed, there was no bony fusion. There was three inches of shortening. Her general condition was good and it was decided to accept fibrous ankylosis of the hip. She is now walking well with a raised shoe.
Comment—The writer believes that in such a case bony fusion may be obtained by fitting the greater trochanter into an excavation made in the ischium just below the acetabulum; this would enable a firm fit to be obtained. It has been attempted in a recent case, similar to this one.

Case 14. *Tuberculosis of the hip with infected sinus*—A boy aged fourteen years was admitted with a four-year history of pain in the left hip. He had been treated conservatively in Tanganyika. On admission he had a discharging sinus over the greater trochanter. Radiographs showed complete destruction of the head and neck of the femur. After a preliminary course of chemotherapy abduction arthrodesis was carried out in two stages. After three months the hip was not quite firm; another plaster spica was applied. Two months later fusion was sound. The sinus was healed and he was able to walk well with a patten to correct five inches of shortening. Eighteen months after operation he returned with a small sinus anterior to the hip. At operation a small amount of superficial necrotic material was removed. The sinus healed rapidly. He was advised to return later for leg equalisation.

Case 15. *Tuberculosis of hip with infected sinuses*—A boy aged twelve years was admitted with quiescent tuberculosis of the chest and of the lumbar spine, and active disease of the right hip. There were four discharging sinuses round the joint. He had been treated conservatively for one year before admission here. Radiographs showed marked erosion of the acetabulum. The femoral head was displaced into the pelvis and appeared to be sequestrated. The hip was immobilised and a two-month course of streptomycin was given. At the end of this time his condition was much improved but the sinuses were still discharging slightly. The first stage of abduction arthrodesis was undertaken. At operation the sequestrated femoral head was removed from the pelvis via the joint. The second stage was done six weeks after the first. Three months later both hip and osteotomy were firm. He left hospital with a raised shoe to correct one inch of shortening. His condition at that time was good, the sinuses were completely healed, and he walked well.

Case 16. *Healed septic arthritis of hip*—A girl aged twenty years was admitted with a history of an acute febrile illness in early childhood, resulting in a marked limp and two inches of shortening of the lower limb. Radiographs showed an upward dislocation of the hip and marked deformity of the femoral head and neck, due presumably to septic arthritis of infancy. The first-stage operation was undertaken soon after her admission. It was found possible to lever the greater trochanter downwards into the acetabulum. Osteotomy of the femur was done three weeks later. After three months the osteotomy did not appear quite united and a further plaster spica was applied. Two months later both hip and osteotomy site were firm. There was no shortening of the leg. She is now walking well.

Our thanks are due to the Director of Medical Services, Kenya, for permission to publish this paper.

TENDER HEEL DUE TO PAGET'S DISEASE

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The following reports are of two patients who attended the out-patient department complaining of pain in the heel and were found to have Paget's disease of the calcaneum. This is of some interest because of the apparent rarity of the condition. The diagnosis was difficult because the primary complaint in both cases was of pain in the heel. In one there were no symptoms suggesting Paget's disease and in the other only on further questioning were suggestive symptoms elicited. In the first case there was no radiographic evidence of involvement of other bones; in the second the skull, spine and pelvis showed typical appearances of Paget's disease.

CASE REPORTS

Case 1—A woman aged seventy-seven years complained of pain in the left heel of one year's duration. The pain was like "pin-pricks"; it was present especially after walking but was felt also at night in bed. There had been no previous symptoms in the heel.

FIG. 1

Case 1—The left calcaneum shows a trabecular pattern of a coarser and denser type than normal.

FIG. 2

Case 2—The right calcaneum shows coarse dense trabeculation. There is a small calcaneal spur.

On examination, there were none of the usual signs of Paget's disease, and no visible abnormality was observed in the left heel. But tenderness was elicited by pressure on the plantar aspect of the calcaneum and on lateral compression.

Investigations—The Wassermann and Kahn reactions were negative. Serum alkaline phosphatase was 12 King-Armstrong units per 100 millilitres. Serum inorganic phosphate was 3 milligrams per 100 millilitres, and serum calcium 10·2 milligrams per 100 millilitres.

Radiographic examination showed no evidence of Paget's disease in the skull, spine, pelvis or upper femora. The left calcaneum showed a trabecular pattern of a coarse and dense type, especially in the main system of striae (Fig. 1).

Progress—A sorbo rubber pad inside the shoe was recommended. The pain gradually diminished during the following six months and no further treatment was requested.

Case 2—A man aged sixty-seven years complained of pain in the right heel of three months' duration. The pain was sharp in nature, "like walking on a broken bone." It became worse on walking and occurred at night while in bed. There was no history of injury or of previous symptoms in the heel. On further questioning, he stated that he had had fleeting pains in the back for about eight years and more recently he had noticed pains in the head, but these had not necessitated medical advice. Prostatectomy had been performed nine years before for benign hypertrophy but there had been no subsequent urinary trouble.

On examination, there were no signs of Paget's disease. There was no visible abnormality of the right heel but the right calcaneum was tender on pressure as compared with the left. Tenderness

was elicited by pressure on the plantar aspect and on lateral compression well away from the plantar surface. The tenderness on lateral compression suggested that spur formation was not the primary cause of the tenderness (Fig. 2). On rectal examination a normal post-prostatectomy bed was palpated.

Investigations—The Wassermann and Kahn reactions were negative. The total serum acid phosphatase was 2 King-Armstrong units; prostatic phosphatase 1 unit; and serum alkaline phosphatase 30 units. Serum calcium was 11 milligrams per 100 millilitres and serum inorganic phosphorus 3 milligrams per 100 millilitres.

Radiographic examination showed well marked signs of Paget's disease in the skull, in the fourth and fifth lumbar vertebrae and in the pelvis. The right calcaneum showed a trabecular pattern of a coarse and dense type, especially in the main system of striae. A small calcaneal spur was present (Fig. 2).

Progress—A sorbo rubber pad inside the shoe was recommended. The pain diminished over the following six months, and no further treatment was necessary.

DISCUSSION

Paget's disease of the calcaneum is not so rare as is generally considered. It is usually diagnosed in association with Paget's disease of other bones on routine examination, and is of secondary interest. It may or may not cause symptoms of tender heel. However, in these two patients the primary complaint was of pain in the heel, and Paget's disease of the calcaneum was discovered only after radiographic examination. The value of radiographing both heels for comparison is evident. Further radiographs of other parts of the skeleton may be necessary for confirmation.

Fairbank (1950) stated that in Paget's disease the radiographs may show an alteration in striation in any bone, particularly in the pelvis, sacrum, vertebral bodies and calcaneum. He quoted Holland (1925) as saying that the appearance of striation in the calcaneum is to be regarded as an early sign of diagnostic value. Holland (1925) stated that if there is a suspicion of Paget's disease, a complete skeletal survey might clear up the diagnosis and for this purpose the bones of the skull and the calcaneum are especially important.

Brailsford (1951) has seen three or four cases of Paget's disease of the calcaneum without demonstrable lesions in other bones and about twenty in which Paget's disease was present elsewhere. He adds that in some patients fracture of the calcaneum has occurred from violence which might not have fractured a normal bone.

Lasserre and Clave (1940) reported a case in which the primary complaint was pain in the heel. Radiologically they suspected the condition to be due to Paget's disease of the calcaneum and confirmed the diagnosis by radiographic examination of the skull.

SUMMARY

1. Two cases of Paget's disease of the calcaneum are reported; in both, the primary complaint was of pain in the heel.
2. In the first case there were no demonstrable lesions elsewhere, but in the second the typical radiographic appearances of Paget's disease were shown in other bones.
3. The literature on the subject is briefly reviewed.

I wish to thank Mr R. H. Metcalfe, Consultant Orthopaedic Surgeon, for his advice and permission to report the above cases, and Dr R. L. Quilliam, Consultant Radiologist, for his help and permission to use the radiographs.

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MALFORMATION OF LUMBAR SPINAL ROOTS AND SHEATHS IN THE CAUSATION OF LOW BACKACHE AND SCIATICA

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It is well established that lumbar root compression, resulting in pain in the lumbar region and sciatica, may be caused by a variety of lesions, such as herniation of intervertebral discs, hypertrophy of the ligamentum flavum, osteochondrosis and spinal neurinomata. It is also well known that identical symptoms may develop in cases of root adhesion and radiculitis.

Within recent years four cases of malformation of lumbar roots and sheaths have come under the observation of the authors, displaying clinical changes which are grossly indistinguishable from those found in the conditions mentioned above. In reviewing the recent literature we have been unable to find such malformations described in conjunction with the problem of low back pain and sciatica.

CASE REPORTS

Case 1—Woman aged thirty-one years. At the age of nineteen she had for a period of about three months suffered from a dull pain in the back of the right thigh and calf. This was relieved by manipulation. Eighteen months before entering hospital she began to complain of pain in the lumbar region. Some months later the pain began to pass to the back of the right thigh, and eventually also to the calf and the great toe. She had noticed a transitory tingling numbness in the right foot. The pain was made worse by coughing, sneezing and by bending forwards. Repeated manipulations had led to no improvement.

Examination—There was obliteration of the lumbar lordosis. The range of spinal movements was slightly limited. There was no local tenderness. No weakness or disorder of sensation was revealed in the lower limbs. Deep reflexes were all normal. Straight leg raising was slightly impaired and painful on the right.

Lumbar puncture revealed normal pressure conditions. The cerebro-spinal fluid was clear, and the cell count and protein content were normal. *Radiographs* showed slight narrowing of the fourth and fifth lumbar intervertebral discs, but no other abnormality. A diagnosis of herniated intervertebral disc in the lower lumbar region was made.

Operation—Laminectomy of the fourth and fifth lumbar vertebrae was performed. No protrusion of the two lower intervertebral discs could be found, but a peculiar affection of the fifth lumbar and first sacral nerve roots was seen (Fig. 1). From the region where the fifth lumbar root normally shoots off, a dural pouch extended laterally for about half an inch. In this were contained the fifth lumbar and first sacral roots which, more distally, separated into distinct nerves, each passing through its normal intervertebral foramen. Cranio-caudally the pouch measured about three-quarters of an inch, and ventro-dorsally a little less than half an inch. When the pouch had been opened both nerve roots were seen to be covered by a thin arachnoidal sheath; the fifth lumbar root lay most ventrally and passed laterally " below " the first sacral root. There was no thickening of the sheaths or nerves. But ventro-dorsally the pouch with its contents was a little more than twice as thick as a normal root. The dura was closed. The decompression effected by the laminectomy was thought to be adequate treatment.

Progress—Apart from a transient retention of urine the post-operative course was uneventful. She was transferred to her county hospital on the fifth day after operation. At that time she had no pain, and the neurological condition was unchanged. When readmitted almost a year later she related that in the first month after operation she had felt quite well. But after discharge from her county hospital she began to notice a sharp stabbing pain in the left gluteal region. The pain was made worse by straining, stooping and coughing, and would then pass to the small of the back and to the back of the left leg. At intervals the left leg became numb, and the muscles of the right calf felt cramped.

On examination there was still some limitation of movement of the lumbar spine, and there was tenderness on percussion over the third lumbar spinous process. There was slight weakness of

dorsiflexion of the foot on the right. Sensation and co-ordination were normal in both lower limbs. Straight leg raising was restricted by pain on the left. *Lumbar puncture* showed no abnormalities as regards pressure, cell count or protein content of the cerebro-spinal fluid. Radiographs showed the condition after a lumbar laminectomy. Myelography showed an incomplete hold-up of the contrast medium at the level of the lower border of the fourth lumbar body. There was no typical configuration of the radio-opaque medium such as may be seen in intraspinal tumours or arachnoiditis.

Operation—The previous laminectomy wound was reopened. The dural malformation on the right was unchanged. The dura was opened. The fifth lumbar and first sacral roots were lying separately, divided from the remaining roots by a thin membranous covering. When this was opened the roots of the cauda equina were seen to be the seat of a marked adhesive radiculitis (Fig. 2).

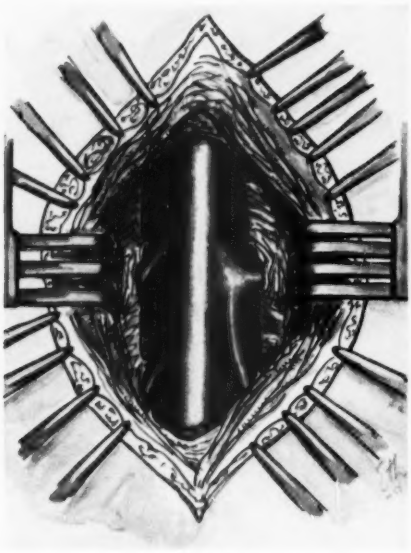

FIG. 1

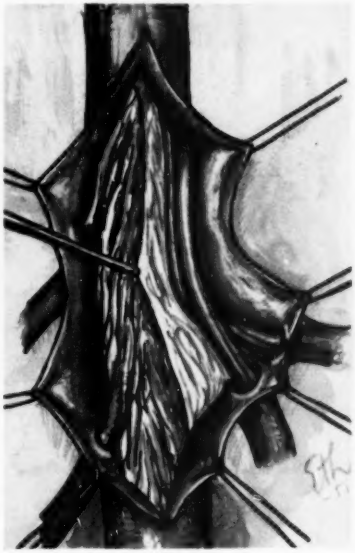

FIG. 2

Case 1. Figure 1—Abnormal dural sac, containing fifth lumbar and first sacral roots on the right. Figure 2—The same case with the dura opened. Abnormal roots shielded from the cauda equina by a thin arachnoidal layer. Adhesions between the roots of the cauda equina.

The lesion was classified as a malformation of the nerve roots and sheaths in the lumbar region, together with an adhesive radiculitis, which was not considered due to the iodized contrast medium.

Progress—After the operation a transient retention of urine again developed. On discharge she had no pain, but complained of numbness in the back of the right thigh, where a doubtful loss of sensation to touch and pain was disclosed. Two and a half years later she reported that the pain in the lumbar region and in the leg was unchanged. She complained of further pain in the left foot. The pain was made worse by straining. There had been no sphincter disturbances since one year after operation. She was able to do light work. On examination there was marked stiffness of the lumbar spine and a mild lumbar scoliosis. Straight leg raising was limited and painful on the left, and there was slight wasting of the left leg. The sensory disorders were unchanged.

Case 2—Man aged forty-seven years. Ten months before admission he had twisted his back by stumbling, when lifting a heavy weight. He felt a " twang " in the lower part of the back, but had no pain in the back until the following day. Since then he had suffered from an almost constant pain in the lumbar region. Two months later the pain passed to the back of the left thigh and the anterior aspect of the left leg as far as the ankle. Pain was aggravated by stooping, coughing and sneezing, but not by straining. He complained of " pins and needles " in the left leg. Manipulations and a course of x-ray therapy did not improve his condition.

Examination—There was reduction of the lumbar lordosis, and movements were slightly restricted in the lumbar spine. There was no weakness or muscular wasting in the legs. The straight leg

raising test was negative. Reflexes were normal. There was blunting of sensation to touch on the anterior side of the left leg, extending upwards to just above the knee. Lumbar puncture revealed no pressure abnormalities and no block; the spinal fluid was clear, and cells and protein content were normal. Radiographs showed no abnormality in the lumbar spine. A diagnosis of herniated nucleus pulposus of the fourth lumbar disc was made.

Operation—There was no major herniation of the disc, but abnormalities of the nerve roots were disclosed (Fig. 3). The fifth lumbar root passed laterally at a rather obtuse angle. From its caudal part a connection was made with the first sacral root, which was split up into a large and a small division. This network of roots was lying a little strained over the slightly protruding intervertebral disc. The dura was left unopened.

FIG. 3

Case 2—Plexiform connection between fifth lumbar and first sacral roots. Caudally a thin second sacral nerve is seen.

Progress—Four months after operation he reported that he still had a tender spot in the back; the previous ache had disappeared. Since the operation the left leg had felt heavy and clumsy. Paraesthesiae were present only in the lateral toes of the left foot when he was lying down. On examination there was still some stiffness of the lumbar spine; no muscular wasting or loss of motor power. No reflex disorders or sensory disturbances. Straight leg raising test was normal on both sides. Two years after operation there was no pain but numbness persisted in the four lateral toes on the left. Examination showed irregular jerks of flexion in left toes, myoclonic in appearance. Only mild loss of sensation to touch and pain in left toes.

Case 3—Woman aged thirty-six years. Seven years before admission she began to get pain in the back. This was almost constant, and for many years was slight. Some months before admission the pain increased in intensity, and was now confined to the right side only. At the same time she noticed numbness and tingling in the lateral border of the right foot. She had never complained of pain in the legs, and there was no aggravation by straining or coughing. No sphincter disturbances.

Examination—The lumbar lordosis was obliterated and there was a slight lumbar kyphosis. There was tenderness on percussion of all lumbar spinous processes. Spinal movements were full. In the lower limbs there was no weakness or muscular wasting; the left patellar reflex was questionably diminished. Sensation to touch and pain was impaired in the right fifth lumbar and first sacral dermatomes. The straight leg raising test was negative. Lumbar puncture revealed no abnormality. Radiographs showed marked narrowing of the fourth lumbar intervertebral space. Myelography showed defective filling of the fifth lumbar root sheath on the right. A diagnosis of herniation of the fourth lumbar intervertebral disc was made.

Operation—The first sacral root and the fifth lumbar intervertebral disc were normal in appearance. The fifth lumbar root was displaced dorsally, passing over a large herniated intervertebral disc. The herniation was removed, together with most of the atrophic nucleus pulposus.

Progress—She was transferred to her county hospital, where she was kept in bed for two weeks. On discharge home she felt quite well, and she returned to work a month later. Six months after the operation she was readmitted for further treatment. She stated that numbness and paraesthesiae had developed in the left foot some days after the operation. Later these sensations had passed to the lateral side of the left leg. They were most marked when she was lying down. Two months before readmission she began to get pain in the left lumbar region and the left buttock. This was made worse by stooping, sneezing and coughing. At the same time she noticed numbness and weakness of the left foot.

Examination—There was slight scoliosis to the right of the lumbar spine; the normal lordosis was obliterated. Spinal movements were full. There was weakness of dorsiflexion of the left foot. Left patellar reflex was diminished. There was loss of sensation to touch and pain in the left fifth lumbar and first sacral dermatomes. Lumbar puncture showed no abnormality. Myelography showed a defective filling on the left at the level of the fifth lumbar intervertebral disc. She was thought to have a herniation of the fifth lumbar intervertebral disc, or a recurrent herniation of the fourth.

Operation—The fifth lumbar lamina was displaced dorsally on the left side, and there was an appreciable enlargement of the fifth lumbar intervertebral foramen. The fifth lumbar and first sacral roots emerged from a common dural sheath (Fig. 4). This was a little more than twice as thick as a normal root with coverings. This double sheath coursed caudally to the level of the fifth lumbar intervertebral disc, where it split up in two separate roots. Both roots left the spinal canal through the fifth lumbar intervertebral foramen. No root was found in the fourth foramen. The dura was left unopened. The abnormal roots were satisfactorily decompressed.
Progress—Five months after the operation she had no complaints. She had returned to work. There was no stiffness of the lumbar spine, some regression of sensory disorders. Straight leg raising test questionably positive on the left. Her condition otherwise unchanged.

FIG. 4

Case 3—Common dural sheath for fifth lumbar and first sacral roots, which split up caudally into separate roots, both passing through the fifth lumbar intervertebral foramen.

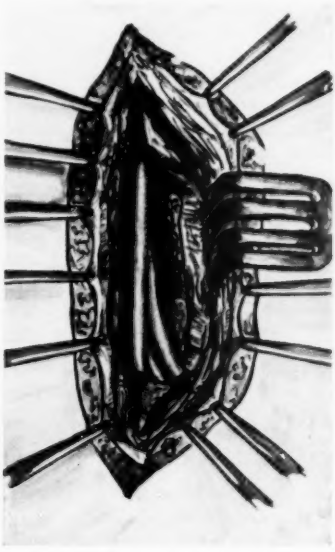

FIG. 5

Case 4—Abnormal offshoot of fifth lumbar nerve, which is considerably enlarged, passing through the fifth lumbar intervertebral foramen together with the first sacral nerve.

Case 4—Man aged forty-nine years. Twenty years before admission he had sustained a head injury in a fall. He was unconscious for five hours. The spine was not injured. He made a rapid recovery and returned to heavy manual work. Twelve years before admission he began to have attacks of sharp lumbar pain of sudden onset, with recovery in a few weeks. Eighteen months before admission the pain became more constant and was now made worse by stooping, jarring, coughing and straining. One year before admission the pain radiated to the back of the right calf and foot and toes. At the same time he noticed numbness and weakness of the foot. He was not relieved by manipulations.
Examination—The lumbar lordosis was obliterated, and there was a mild lumbar scoliosis towards the right. Spinal movements were slightly restricted. There was slight wasting of the muscles in the right thigh and calf, with marked weakness of dorsiflexion of the right foot and toes. Sensation to touch was impaired in the right fifth lumbar and first sacral dermatomes. The straight leg raising test was negative on both sides. Reflexes were normal. The gait was unsteady with dragging of the right foot. Lumbar puncture revealed no abnormality. Radiographs showed a slight narrowing of the fifth lumbar intervertebral space, and a mild spondylosis. A diagnosis of herniation of the fourth lumbar intervertebral disc was made.
Operation—No disc protrusion was found. The fifth lumbar spinal nerve was anomalous both in

its course and appearance. It left the dural sac about an inch more caudally than normal and as it coursed caudally and laterally it lay close to the first sacral nerve and passed through the same intervertebral foramen. The nerve was enormously thickened (Fig. 5). Along the dorsal surface of the nerve an enlarged tortuous vein was seen. In the cranial part of the field the fourth lumbar nerve was seen passing the third intervertebral disc, but none was found passing the fourth lumbar disc. The first sacral nerve was normal. On palpation no intradural abnormalities were detected, but the dura was not opened. A satisfactory decompression was made.

Progress—On discharge he complained of a " tightening " in the left foot. The weakness of the foot and sensory disturbances were unchanged. Ten months later he reported that he had no pain, but the dropping of the right foot persisted. He was able to work. Examination showed no stiffness of the lumbar spine. The right foot was dropped and the left ankle jerk diminished. The straight leg raising test was negative. Sensation to touch and pain was impaired on the back of the foot and the great toe on the right.

DISCUSSION

All these patients with malformation of lumbar roots and sheaths gave histories indistinguishable from those of herniated intervertebral disc. The history was long, the course intermittent, and the initial symptom pain in the small of the back, eventually followed by pain in the leg. It should be noted, however, that the findings on neurological examination were more marked than is usual in cases of intervertebral disc herniation. Although in some cases of disc prolapse similar changes may develop, the occurrence in the cases reported here of weakness of dorsiflexion of the foot and the loss of sensation is striking. Furthermore, it is noteworthy that the straight leg raising test was so commonly negative.

The cerebro-spinal fluid revealed no abnormalities. Lumbar puncture is therefore of no value in differentiation between the condition we are considering and herniated disc, although it enables us to rule out a diagnosis of spinal neurinoma. Radiographic examination is of little value in securing the correct diagnosis. Marked narrowing of the intervertebral space was shown in only one case, in which a herniated nucleus pulposus was found and removed. Otherwise, only slight narrowing was seen, such as is often observed in cases of herniated intervertebral disc, and of lumbar osteochondrosis and even under normal circumstances.

In each case a pre-operative diagnosis of herniation of a lumbar intervertebral disc was made, and on this basis they were operated upon. The post-operative results suggest that, in practice, it is of little importance whether a correct differentiation has been made pre-operatively between herniation of lumbar intervertebral disc and malformation of roots and sheaths, because surgical intervention in both cases implies a decompressive laminectomy. Two patients had no complaints and were able to do their work satisfactorily; in one the condition was improved and she was able to work. In one case the condition was unchanged or even worse, but in this case marked adhesion-formation in the cauda equina was disclosed—a condition that cannot be expected to improve after operation.

Abnormalities of spinal roots have previously been described by pathologists and anatomists (Zagnoni 1949), and are said to occur with decreasing frequency from the cervical spine caudally. Usually they do not give rise to neurological changes. When such changes develop, as in the cases reported here, it is probably because the abnormal roots and sheaths occupy the entire and limited intraspinal space, so that any diminution of this space by even a slight narrowing of the intervertebral disc may result in compression.

As compared with herniation of lumbar intervertebral disc the frequency of clinically significant anomalies of the nerve roots is low; only these four cases were found in 1,162 cases of lumbar laminectomy performed in this department from April 1943 until July 1951. They are much less common than are lumbar spinal neurinomata, which were found in twenty-five cases in the same period.

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CHANGES IN THE HEAD OF THE FEMUR IN CHILDREN SUFFERING FROM GAUCHER'S DISEASE

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In 1882 Phillipe Gaucher, in his thesis for M.D. of the University of Paris (" D'epithelioma primitif de la rate: hypertrophie idiopathique de la rate sans leucemie "), described a new type of splenic tumour which he thought was an epithelioma; and in 1904 Brill and his collaborators described similar cases which at autopsy showed collections of cells (Gaucher cells) in the bone marrow. Junghagen, in 1926, made the first detailed report on the radiographic changes of bone in a three-year-old girl with Gaucher's disease. The extent of infiltration of bone with Gaucher cells, which contain the lipoid kerasin, determines the particular radiological findings, which in some cases are extensive. Pick (1933) suggested that the predominantly osseous form of Gaucher's disease was usually familial.

In Gaucher's disease the cells infiltrate the liver and spleen, giving rise to the characteristic hepato-splenomegaly; haemorrhages are also frequent because of the infiltration of the bone marrow which leads to thrombocytopenia and leucopenia. Radiological changes are most commonly observed at the lower end of the femur, giving rise to the " Erlenmeyer flask " appearance with expansion of the bone, destruction of the spongiosa and pressure atrophy of the cortex. Later, sclerosis of the shaft of the femur may occur. Probably second in order of frequency are the radiological changes found at the upper end of the femur, and Table I gives details of such changes in seventeen recorded cases. Our two patients also showed similar changes.

CASE REPORTS

Case 1—This was an illegitimate girl first seen in March 1948, when she was five years old. There was a history of severe constipation from birth and failure to grow. On examination she was a pale, thin child with a distended abdomen caused by a spleen which extended from the costal margin to the pelvic brim. The skull was microcephalic and there was a flexion deformity of all the terminal phalanges. A splenic puncture was performed and typical Gaucher cells were seen when the aspirated material was examined. The blood Wassermann was strongly positive, but the Wassermann reaction of the cerebrospinal fluid was negative; the mother's Wassermann reaction was negative and no history of anti-syphilitic treatment was obtained from her. Injections of " bisoxyl " and penicillin were advised for the child, and after five months' treatment the blood Wassermann reaction became negative. Splenectomy was undertaken and the spleen weighed 1,200 grammes. She was seen subsequently on several occasions in the out-patient department and her condition improved until ten months after operation, when she complained of pain in the left thigh. On clinical examination she walked with a limp, there was no muscle wasting but abduction and medial rotation of the left hip joint caused pain. Radiographs (Fig. 2) showed blurring of the upper epiphysial line of the left femur, with osteoporosis of the medial side of the head and of a circumscribed area of the neck. The pain was quickly relieved by a short period of rest and there were no further symptoms until three months later, when the pain and limp returned. In December 1949 radiological changes suggestive of Perthes' disease of the left femur (Fig. 3) were present. She was readmitted to hospital and weight-traction was applied for one month. After this she spent a period of two months on an abduction frame until a patten-top caliper was fitted and she was then seen as an out-patient. Serial radiographs are reproduced (Figs. 1 to 5) and show that the changes in the femoral head were progressive and without evidence of regeneration.

Case 2—This boy first attended hospital at the age of three years and was operated upon for a small umbilical hernia and a right-sided hydrocele. He was readmitted eighteen months later, when his spleen was enlarged to just below the umbilicus. Splenectomy was performed and the

FIG. 1

FIG. 2

Case 1. Figure 1—At first examination. No bony changes shown in hip joints. Figure 2—Eighteen months later. Blurring of the upper epiphysial line of left femur, with osteoporosis of the inner side of the head and of a circumscribed area of the neck. (Opacities over both iliac crests due to intramuscular injections of bismuth.)

FIG. 3

FIG. 4

FIG. 5

Case 1. Figure 3—Twenty months after first examination. Fragmentation of head of left femur. Figure 4—Three months later. Collapse of head of left femur. Two further osteoporotic areas present in neck of left femur. Figure 5—Eight months later. Marked flattening of head of left femur, with translucent areas.

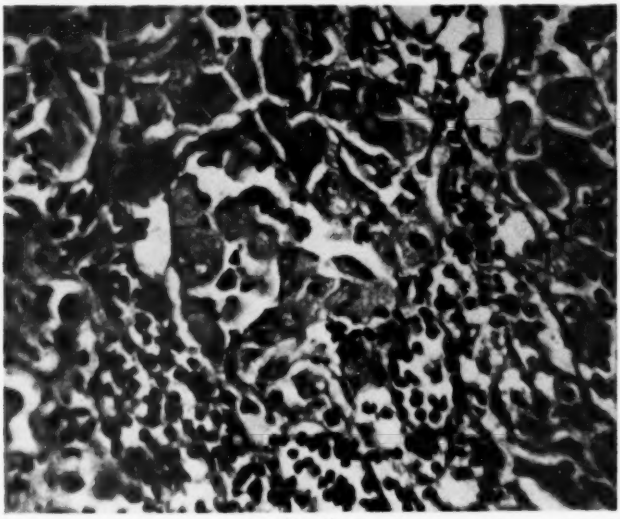

FIG. 6

Case 2—Section of spleen, removed at the age of four and a half years, showing typical Gaucher cells (×360).

FIG. 7

FIG. 8

Case 2. Figure 7—Right hip at the age of nine and a half years, showing irregular sclerosis with some flattening of the femoral epiphysis. The femoral neck is widened and there is a circumscribed area of osteoporosis with some surrounding sclerosis on the medial side of the neck. Figure 8—Enlarged radiograph of the femoral neck showing the same changes as in Figure 7 and, in addition, irregularity of the acetabular margin and widening of the joint space.

spleen, which weighed 500 grammes, contained typical Gaucher cells (Fig. 6). Subsequent history was uneventful until he was readmitted to hospital at the age of nine and a half years with severe pain in the right thigh for one day, following a sore throat one week before; he was referred as a suspected case of osteomyelitis. On examination he was a pale, thin boy, with the right leg flexed at the hip and knee, and limitation of all movements of the right hip joint because of muscle spasm. A non-tender bony swelling at the lower end of the right femur was noted. Radiographic changes were present at both ends of the right femur; the changes at the upper end are reproduced (Figs. 7 and 8).

Sternal puncture was performed and typical Gaucher cells were found. Treatment of the hip lesion consisted of fitting a Patten-top caliper. While in hospital his tonsils were removed and typical Gaucher cells were seen on microscopical examination. He has been seen at intervals of six weeks since discharge from hospital, and the radiological appearances of the right femur are unchanged.

DISCUSSION

The radiological changes in the femoral head in these two patients resemble those encountered in Legg-Calvé-Perthes' disease. The nature of this condition has been investigated by many workers, and Brailsford (1948) enumerates eleven theories of causation, including trauma, infections, endocrine disorders, vascular causes and congenital lesions. He considers that the disease is "the reaction associated with hyperaemia and decalcification which is produced in the living bone by adjacent avascular bone." This avascular fragment is gradually absorbed as a result of infiltration by blood vessels, and eventually new bone is deposited. Many factors may be responsible for the initial disturbance of blood supply to the avascular fragment of bone, and in many cases trauma appears to be a contributory factor.

In Gaucher's disease, cells 20 to 80 μ in diameter provide the characteristic microscopical feature, and they are found in many organs, including the bone marrow. Destruction of bone may result either from multiplication of Gaucher cells with subsequent pressure atrophy of bone, or from interference with blood supply by embolism or thrombosis.

Biopsy of the femoral head in Perthes' disease has been undertaken infrequently, but Cushing and Stout (1926) reported the pathological findings in a woman of thirty-three years with "Perthes' syndrome" due to Gaucher's disease. The head and neck of the patient's right femur were removed together with six sequestra from the acetabulum. On macroscopical examination the bone was soft, the marrow spaces were enlarged and the marrow had a pale pink tinge. Very little articular tissue remained on the head of the femur and the cartilage was patchy and of unequal thickness. Microscopically Gaucher cells were present within the marrow cavity and the authors concluded that the changes encountered resulted from multiplication of these Gaucher cells, followed by gradual disintegration of the joint.

Melamed and Chester (1938) described the post-mortem appearances in a man of twenty-six years with Gaucher's disease showing radiological flattening of the head of the left femur. The lower proximal part of the articular surface was completely destroyed and the cartilage was absent. There was an area of softening in the head of the femur, filled with soft, greyish-pink tissue, and several nodules of friable, yellowish tissue were also present which completely replaced the normal structure. Reiss and Kato (1932) considered that pressure on surrounding tissues by accumulation of Gaucher cells causes necrosis of the spongiosa leading to rarefaction of the cortex. When necrosis occurs at the epiphysis pathological fractures may occur, and if the adjoining joint surfaces are invaded, chronic arthritis ensues.

When Gaucher cells infiltrate the shaft of a bone, radio-translucent areas result, and although similar areas occur in the neck of the femur, the head usually shows an increased density. This appearance cannot be explained by multiplication of Gaucher cells in the bone marrow, but similar changes occur in diseases which interfere with the arterial supply to the bone and produce aseptic necrosis. Pick (1925) found Gaucher cells in the adventitia of small arterioles, and Graham and Blacklock (1927) noted masses of Gaucher cells in the lumina of branches of the splenic vein, as well as small nests of Gaucher cells clustered around very

fine capillary vessels in the liver. It seems reasonable to postulate that similar involvement of the arterioles supplying the femoral head may occur and give rise to aseptic necrosis. Arkin and Schein (1948) consider that the clinical and radiological features of Gaucher's disease involving the femoral head are most satisfactorily explained by a vascular cause producing aseptic necrosis of bone. Furthermore, similar changes at the femoral head have been reported by Wintrobe (1946) in leukaemia. In the two cases here reported biopsy of

TABLE I

SEVENTEEN CASES OF GAUCHER'S DISEASE WITH HIP CHANGES IN CHILDREN REPORTED IN THE LITERATURE

Author	Year	Age of child (*years*)	Sex	Author's description of hip changes
JUNGHAGEN	1926	4	F	Left hip— Epiphysis of left femoral head partly disappeared leaving a larger lateral fragment and a conglomeration of smaller barley-like fragments bordering the outer edge. Compression of epiphysial centre
LINDAU	1928	3	F	Left hip— ? T.B. Decalcification and pronounced spottiness owing to round or oblong structural defects of different size in spongy bone
WELT, ROSENTHAL, OPPENHEIMER	1929	8	F	Both hips—Mottled appearance of head and neck
REISS, KATO	1932	5	F	Both hips—Femoral necks markedly sclerosed. Deformed appearance of head resembling Perthes' disease. Pathological fracture of neck on right side
		5	M	Both hips—Epiphyses showed gross irregularity of epiphysial lines associated with coxa vara
DE LANGE	1938	8	F	Left hip— Fracture of neck with sclerosis of head
		7	F	Left hip— Destruction of head
PACHMAN	1938	7	M	Both hips—Diffuse decalcification with small areas of destruction in femoral necks
		9	F	Right hip—Acetabulum irregular with large areas of destruction especially of ilium. Porosis and angulation of femoral head
THANNHAUSER	1940	7	M	Both hips—Complete flattening of left femoral head. Perthes'-like changes in right femoral head
PERLMAN	1940	6	M	Right hip—Coxa vara, and " osteomyelitis " of neck: irregular density and rarefied areas
SCHEIN, ARKIN	1942	10	F	Left hip— Perthes'-like changes
		10	F	Left hip— Perthes'-like changes
		5	M	Right hip—Pathological infraction with coxa vara
		14	F	Both hips—Mushrooming of femoral heads with coxa vara
ARKIN, SCHEIN (also MELAMED, CHESTER, 1938)	1948	12	M	Left hip— Perthes'-like changes
DRAZNIN, SINGER	1948	10	F	Both hips—Perthes'-like changes

bone has not been undertaken. However, the spleen of each patient has been examined microscopically but we have been unable to demonstrate any vessels directly infiltrated by Gaucher cells.

At the present time no effective therapy is available for the cure of Gaucher's disease, but splenectomy is frequently undertaken for relief of symptoms. This operation is usually advised either to relieve abdominal pain and discomfort, or to prevent haemorrhages and

the development of anaemia, which commonly occurs. There is general agreement that pain is relieved, anaemia is improved and haemorrhages cease after the operation, but some writers suggest that the development of bone changes may be accelerated by splenectomy.

The radiological bone changes in our cases were first noted in one thirteen months and in the other five years after operation. Of the seventeen children with Gaucher's disease showing involvement of the head of the femur reported in the literature, Lindau's (1928) patient developed bone changes within four months of operation; but in others—for instance in Welt's (1929) patient—bone changes were not observed until four years after operation. In adults even longer periods have elapsed between splenectomy and subsequent bone changes.

Pick (1933) has pointed out that in some instances of this disease the osseous changes predominate, and he cites a family of five brothers suffering from this condition. Furthermore, the bone changes—as in Cushing and Stout's (1926) patient—may be present before splenectomy is undertaken. Heilbron (1935) has suggested that splenectomy might prevent further bone changes, and in support of this he reports two children (subsequently described by De Lange in 1938) the younger of whom had a splenectomy and showed post-operative improvement of the skeletal changes, and the elder, who did not undergo splenectomy, developed typical bone changes. Subsequent observation of the younger child, however, showed the development of progressive bone changes. Gaucher's disease is a progressive condition and we consider it unlikely that splenectomy affects either the onset or development of bone lesions.

Local treatment of the involved hip may have a distinct bearing on prognosis of the bone lesion and Arkin and Schein (1948) describe the clincial features in a girl first seen at the age of ten years in whom, after bed rest, reconstruction of the head of the femur occurred to such an extent that the radiographic and clinical features were almost normal. These authors suggest that the advanced degenerative lesions of the hip occasionally seen in adult patients are likely to be due to lack of protection from weight-bearing in childhood when the hip is more pliable. The improvement would support the hypothesis that the changes are due to an aseptic necrosis, unless the Perthes' disease in this case was coincidental, and not due to Gaucher's disease.

The blood Wassermann reaction in Case 1 was strongly positive on several occasions, but no clinical signs of syphilis were present. The cerebrospinal fluid was normal, including negative Wassermann reaction. The Wassermann reaction of the child's mother was negative and she denied receiving anti-syphilitic treatment. The child was illegitimate and as the father's identity was unknown his blood Wassermann reaction could not be determined. In the cases of Gaucher's disease reported in the literature none have had a positive Wassermann reaction, and the standard text-books state that in Gaucher's disease the blood Wassermann reaction is negative.

Kolmer (1949) has reviewed the diseases, other than syphilis, in which the blood Wassermann reaction is positive. In addition to diseases usually found in tropical countries, such as malaria, leprosy, filariasis and leishmaniasis, the blood Wassermann reaction has occasionally been reported positive in viral pneumonias, vaccinia, infectious mononucleosis, lupus erythematosus and subacute bacterial endocarditis. In our patient no other disease was present, and technical errors in the carrying out of the test were unlikely as the result was strongly positive on several occasions. Stokes *et al.* (1946) performed routine Wassermann reaction on blood obtained from 210,261 blood donors and found a positive reaction in 489 (0·23 per cent). Nearly half of these 489 cases were finally adjudged to be syphilitic, but no cause could be found in the remainder. Furthermore, they found that the non-specific reactions were usually of low titre but occasionally a strongly positive reaction was obtained. In our patient, a diagnosis of congenital syphilis was made, and after five months of anti-syphilitic treatment the blood Wassermann reaction became negative. The bone changes in this girl were not typical of syphilis and it is considered unlikely that syphilis played any part in the

changes present in the femoral head, because they developed fourteen months after anti-syphilitic treatment had been completed and at a time when the Wassermann reaction had become negative.

SUMMARY

1. Two children suffering from Gaucher's disease, who developed changes in the femoral head typical of Perthes' disease, are reported. Similar changes have been recorded in the literature in seventeen children under the age of fifteen years.

2. The possible factors giving rise to the bone changes are discussed and it is considered that they result from aseptic necrosis. Splenectomy does not appear to hasten the development of bone changes in this disease.

3. In one of the patients, the blood Wassermann reaction was positive, but syphilis was not thought to play any part in the production of the bone changes.

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GAUCHER'S DISEASE IN BONE

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The first complete radiological investigation of Gaucher's disease in bone has been attributed to Junghagen in 1926. Pick (1933) gave the classical account of the clinical features of the disease, and most authors have followed his conceptions more or less closely, with a few dissenters. In his paper, Pick distinguished an "osseous type" with predominantly an osseous distribution, stating that "scarcely a bone is spared." He suggested a constitutional predisposition and supported this contention with an example of a whole generation who exhibited osseous lesions in those members affected. More recently a familial incidence has been recorded in which a non-osseous lesion predominated (Morgans 1947). Many case records in the literature have shown the disease to have commenced with splenomegaly and to have developed osseous lesions later. Indeed, so often has this order of progress of the disease been encountered that some writers have suggested that spread to the skeleton has been precipitated by splenectomy. Others have maintained that splenectomy increases resistance to acute infections and therefore is a desirable form of treatment (Logan 1941).

According to Pick, the typical lesion occurring in the femoral head consisted of "an invasion of the femoral head with subsequent collapse and deformity, leading to a deforming arthritis." Reed and Sosman (1942) have supported this finding and describe a "pathological fracture occurring in the destructive types of lesion." They state that the deformity occurring in hip lesions is to be distinguished from Perthes' disease, tuberculous disease and chronic osteomyelitis.

Microscopic examinations made by Pick showed the marrow to be interspersed with nodules of varying size, partly encapsulated, packed with cells of typical type and containing the distinct staining characteristics associated with the more usual non-osseous lesions. Cushing and Stout (1926) demonstrated the presence of large cells in the marrow of the femoral head and neck, producing an "osteo-arthritis with sequestrum formation." They also observed that the cells found in the bone marrow frequently assumed a spindle formation which was thought to be the result of mutual compression. It is possible that such compression may influence adversely the vascularity of the bone adjacent to the infiltrated areas. More recently Schein and Arkin (1942) have suggested that vascular obstruction was due to direct infiltration of the vessels by Gaucher's cells. In early descriptions many patients were wrongly described as suffering from osteomyelitis, and it may be that true sequestrum formation was the direct outcome of surgical drainage.

Other general features common to all forms of Gaucher's disease include patchy pigmentation of the skin and deposits occurring in the sclera, known as pingueculae. A haemorrhagic diathesis is also alleged to occur.

The following case report illustrates apparent resolution of the disease in one area, while further spread occurred in other zones of the affected bone and in other parts of the skeleton. A note is added on the value of deep x-ray therapy.

CASE REPORT

A young unmarried woman aged nineteen years gave a history of pain and limp affecting the right hip for the previous six months. There was a history of splenectomy four years before, undertaken because of pain in the left hypochondrium associated with splenomegaly. At that time blood counts, sternal puncture and skin biopsy failed to show any evidence of infiltration by Gaucher's cells. Examination of the spleen, however, confirmed the diagnosis

FIG. 1

Right hip at time of admission at age of nineteen years. Note depressed avascular fragment at upper segment of femoral head.

FIG. 2

FIG. 3

Figure 2—Three months later. In addition to the changes in the femoral head an early cystic appearance is shown in the shaft. Figure 3—Three months later still. Note absorption of avascular fragment.

of Gaucher's disease. At that time no radiographic investigation of the skeleton had been conducted.

On examination there was apparent shortening of the right lower limb, a slight flexion contracture of the right hip and marked limitation of all movements due to pain. Radiographs showed changes suggestive of a form of osteochondritis of the right femoral head (Fig. 1), together with evidence of cavitation in the upper extremities of the shafts of both femora. *Treatment*—Traction was applied to both lower limbs and maintained for nine months, during which there was progressive improvement in the radiographic appearance of the femoral head. The previously avascular segment in the upper half of the head appeared to become gradually revascularised (Figs. 2 and 3). The hip was subsequently immobilised in a plaster spica for seven months, after which she was discharged home wearing a short spica.

FIG. 4

FIG. 5

FIG. 6

Figure 4—Right hip showing pathological fracture through cystic area at upper end of shaft. Figures 5 and 6—Progressive changes in the femoral shaft below the pathological fracture. Figure 5 shows the condition four months after the fracture. Figure 6—Five months later.

Progress—The patient later sustained a pathological fracture through a cystic area in the upper end of the right femoral shaft (Fig. 4). Traction was reapplied and immobilisation resumed in recumbency. Radiographic studies were continued during the following months. Progressive destruction of the cortex of the shaft of the right femur was observed below the level of the fracture (Figs. 5 and 6). In the left femur infiltration of the marrow cavity was seen to continue (Figs. 10 and 11), but progressed less rapidly than the changes in the right side. During these studies it was observed that the characteristic flask-like enlargement of the lower femoral shaft (Fisscher's sign) did not occur in this patient, in spite of the severity of the lesion higher up the shaft. Biopsy was performed, scrapings being obtained both from

the base of the neck of the femur and from the upper cystic segment of the shaft. Both specimens were reported to contain massive infiltration by Gaucher's cells, in spite of apparent resolution as seen radiographically.

Response to x-ray therapy—It has been commonly accepted that Gaucher's disease is unaffected by deep x-ray therapy. In this instance, however, it was decided to give this form of treatment a trial. The response was striking, especially in areas of the right femur in which cortical destruction had occurred (Figs. 7 to 9). Later radiographs suggested that the process had been halted and that there had been an actual increase in the number, dimensions and density of the trabeculae (Fig. 9). The total irradiation given was 2,500r and represents the estimated tumour dose at the centre of the limb. Treatment for the left femur was begun later and the response was satisfactory (Figs. 11 and 12).

FIG. 7 FIG. 8 FIG. 9

Right femur showing response to radiation therapy. Figure 7—Two months after radiation (seven months after radiograph shown in Figure 5). Figure 8—One and a half years after radiation therapy. Figure 9—Three and a half years after radiation.

DISCUSSION

This case presents several unusual features. At the time of splenectomy and possibly before any appreciable osseous involvement had occurred, no deposits of cerebroside were found in the skin biopsy from areas of doubtful pigmentation. Sternal puncture was at that time negative. Regression of the process occurred in one area of an affected bone, while progressive infiltration occurred elsewhere in the same bone and in other parts of the skeleton.

The writer considers that the progressive absorption of the avascular fragment of the femoral head could not have occurred if the blood vessels were infiltrated with Gaucher's cells as suggested by Schein and Arkin (1942). Biopsy, performed after absorption was

FIG. 10

Left femur at age nineteen, shortly after admission. Early cystic appearance present in upper part of the femoral shaft.

FIG. 11 FIG. 12

Figure 11—Two years later: changes more marked, but less severe than in right femur. Figure 12—Four years later still, showing condition two years after treatment by radiation.

complete, confirmed intensive infiltration of the femoral neck with Gaucher's cells. It is possible that if weight-bearing and muscle pull are eliminated, an adequate blood supply may be restored ultimately.

Deep x-ray therapy appears to afford some hope of success in arresting the progressive infiltration of bone, and there is evidence to suggest that increased trabeculation can be induced. Contrast of the early radiographs with the most recent films taken six years after the condition was diagnosed and three and a half years after treatment by deep x-ray therapy, show many interesting features (Figs. 7 to 9 and Fig. 12). There appears to have been a cessation of the process of cortical disruption in the shaft of the right femur. The outline of the femoral head has regained a reasonable shape. No further extension of the medullary cavitation of the left femur occurred and in fact the writer considers that there has been some regression and retrabeculation after deep x-ray therapy.

Although this patient has been examined at regular intervals over the past six years, no further spread has been found in other parts of the skeleton. It may be that the pathological process has been arrested: certainly there seems to be no doubt that it has been slowed very appreciably, when one remembers that most of the infiltration appears to have occurred in the first three years that the patient was under observation.

It may be argued that retrogression was already occurring in the first lesion in the femoral head before irradiation was begun. Nevertheless, the recent films do not indicate any evidence of the " deforming arthritis " to which Pick (1933) referred in his account, and which appears to be the usual outcome in untreated cases.

I am indebted to Mr A. M. Hendry of Birmingham for permission to publish this case and for the interest which he has taken, and to Sir Reginald Watson-Jones for his encouragement.

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GAUCHER'S DISEASE WITH INVOLVEMENT OF BOTH HIP JOINTS

Report of a Case

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The patient, a clerk aged fifty-four years, attended St Bartholomew's Hospital, Rochester, in 1950 complaining of pain in both hips. At the age of twelve years he had had what was thought to be a tuberculous left hip, but he was never treated in bed but only with a Thomas's caliper and crutches. With this treatment his hip recovered completely, but since about 1916 there had been a slow deterioration in the hip both in comfort and mobility. Since that time the right hip also had gradually become stiff and painful. In 1936, when he was aged forty years, an arthroplasty of the right hip was carried out by Mr Laming Evans at the Royal National Orthopaedic Hospital. After this the hip was comfortable and during the recent war he carried out active duties in air raid defence. Since 1945 the right hip had been getting painful again, and he was now only able to walk about half a mile before pain forced him

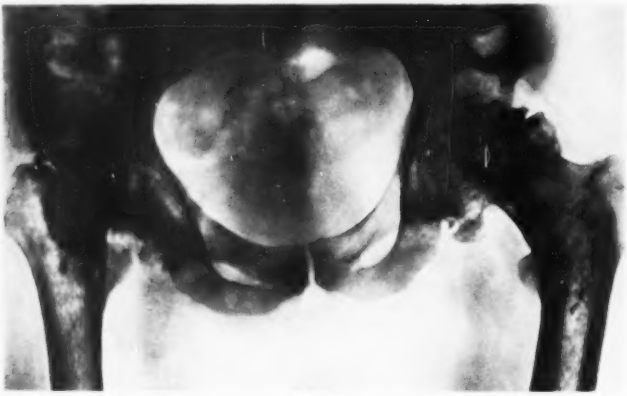

FIG. 1
Pelvis and hip joints.

to stop. The left hip was also painful but to a lesser degree. He had had some pain in the low back after walking. In addition to the operation on the right hip, he had loose bodies removed from the left knee in 1934 and 1941.

On examination he appeared healthy but rather sallow. There were marked triangular subconjunctival lipoid deposits in both eyes. He had a marked lumbar lordosis, secondary to a 70 degrees flexion deformity of the right hip. In the left hip there was a 30 degrees flexion deformity. There was only a degree or so of movement in any direction in the right hip. In the left hip he had a range of active and passive flexion from 150 degrees to 110 degrees. All other movements of the hip were restricted to a few degrees. In the left knee there was movement from 160 degrees to 80 degrees, with crepitus and clicking in the joint and marked lateral instability. The right knee showed no abnormality. On walking and standing there was a bilateral Trendelenberg dip. He could touch his toes, but on resuming the erect position there was a very loud crunch in the right hip. Lateral movements of the spine were free. *Abdomen*—The spleen showed simple smooth enlargement to below the umbilicus. The liver was enlarged three fingers' breadths below the costal margin. *Radiographs* showed gross

arthritis of the left hip with flattening of the femoral head, and gross changes in the structure of the right hip, the head of the femur being absent (Fig. 1). In both hips there were widespread patchy sclerotic changes throughout the upper ends of the femora and adjacent parts of the ilium. In the upper part of the left femur there was an area in which the normal bone pattern was lost. The lower end of each femur showed a " bottle " enlargement with widespread alteration of bony pattern (Figs. 2 and 3). The upper ends of both tibiae showed similar alterations of pattern. The left knee was the site of marked arthritic changes (Fig. 3). Radiographs of the skull, arm and forearm bones showed no evidence of additional deposits, and the lumbar spine showed very little arthritic change.

Investigations—Blood examination showed a mild leuco-erythroblastic anaemia with a red cell count of 3,320,000; haemoglobin was 66 per cent. One per cent of metamyelocytes and two late normoblasts were seen during a differential white cell count of 200 cells. Sternal

FIG. 2
Right knee.

FIG. 3
Left knee.

puncture showed marked normoblastic hyperplasia. Gaucher's cells were not seen. The bromsulphthalein test showed no retention of dye after thirty minutes. Despite the absence of clinching evidence of Gaucher's disease, the diagnosis did not seem in doubt.

Progress—The patient was admitted to the London Hospital three months later for further investigations. The acid phosphatase was found to be raised to 21 units (this was repeatedly checked) and the blood cholesterol was 140 milligrams per cent. Sternal puncture revealed Gaucher's cells present in small numbers. It was noticed that when a sphygmomanometer cuff was applied petechiae appeared over the arm and forearm below the cuff. Further blood investigations were carried out, and these revealed a bleeding time of eight and a quarter minutes and the blood platelet count was reduced to 20,000. The question of treatment for the hips is under consideration.

GAUCHER'S DISEASE WITH PSEUDOCOXALGIA

Report of a Case

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An undersized boy aged four years and ten months was admitted to King's College Hospital in 1946 under Dr Phillip Evans because of failure to gain in weight. There was a past history of frequent colds and malaise. On examination the spleen and liver were found enlarged. There was generalised glandular enlargement. Radiographs of the skull, chest and long bones were normal. Wassermann reaction was negative. Blood cholesterol was 174 milligrams per cent. A tentative diagnosis of Gaucher's disease was made.

Fig. 1

Fig. 2

Figure 1—Radiograph of right hip at the age of six years. Small cystic areas are seen at the medial and lateral margins of the epiphysis. Figure 2—Three months later. The epiphysis is flattened and the cystic areas have enlarged.

Progress—Two years later, at the age of six years, he was readmitted because of pain and limp in the right leg for three months. On examination there was no wasting of the thigh muscles. Flexion of the right hip was full, but rotation and abduction were limited. Radiographs showed a cycle of epiphysial changes in the head of the right femur (Figs. 1 to 6).

Investigations—Gaucher cells were present in sections of bone marrow.

Treatment—Extension was applied in abduction for three months, after which a patten-ended caliper was worn.

FIG. 3

FIG. 4

Figure 3—Three months later a cyst is now visible in the metaphysis. Figure 4—Three months later still. The epiphysis is fragmented and two large cysts are visible in the metaphysis.

FIG. 5

FIG. 6

Figure 5—One year later. Reformation of ossific centre. Figure 6—Recent film, three years after the first (Fig. 1) showing coxa magna. A cystic area is still visible in metaphysis.

Comment—This case of Gaucher's disease is so far devoid of osseous lesions other than those in the right hip joint. The serial radiographs (Figs. 1 to 6) differ from those seen in typical pseudocoxalgia only in the lack of initial condensation of the epiphysis. Arkin and Schein (1948) have drawn attention to the fact that such changes may be brought about by deposits of Gaucher cells in the femoral neck or head.

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GAUCHER'S DISEASE

Report of a Case

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A Hebrew patient of forty-seven years first attended the Orthopaedic Department of the London Hospital in 1949 with a three months' history of pain and stiffness in the right shoulder. There was no history of injury although the onset of pain was rather sudden. His main disability was painful restriction of all movements of the shoulder but particularly of returning the abducted arm to the neutral position. Movements at the shoulder were associated with pain in the region of the acromion, radiating down the outer side of the arm.

Fifteen years before he had noticed that his right hip was a little stiff and occasionally painful, but his hip had never been troublesome enough for him to seek medical advice. An abnormality of the right hip had been noticed during his Army medical examination seven years before.

On examination there were subconjunctival pingueculae in both eyes, largest on the right side.

FIG. 1 FIG. 2

The right hip, showing changes in the head of the femur.

Right shoulder—There was wasting of the deltoid and spinati muscles. Tenderness was noted over the anterior part of the head of the humerus. There was a 30 degrees medial rotation deformity of shoulder joint. Movements were as follows: abduction 55 degrees; abduction with scapular rotation 90 degrees; rotation 20 degrees; extension 20 degrees; forward flexion 90 degrees. *Hips*—There was no shortening and the Trendelenberg test was negative. There

FIG. 3
The right shoulder.

was fixed flexion deformity of the right hip of 20 degrees. Movements of the right hip were as follows: flexion 100 degrees; abduction 10 degrees; adduction 10 degrees; lateral rotation 20 degrees; medial rotation nil. Movements of the left hip were: flexion 150 degrees; abduction 30 degrees; adduction 30 degrees; lateral rotation 20 degrees; medial rotation 40 degrees. There was a full range of movements in both knees. *Abdomen*—The liver or spleen was not palpable.

Radiographic examination—The right hip showed mottled sclerosis and avascular necrosis with some distortion of the head of the right femur (Figs. 1 and 2). The right shoulder showed avascular necrosis of a large segment of the humeral head, with a small detached flake lying antero-inferiorly (Fig. 3).

Investigations—*Sternal puncture* revealed "Gaucher's" cells. *Blood count* showed haemoglobin 100 per cent, leucocytes 5,400 (polymorphonuclears 53 per cent, eosinophils 1 per cent, lymphocytes 41 per cent, monocytes 5 per cent). Bleeding time was 1 minute 15 seconds. Sedimentation rate (Wintrobe) was 6 millimetres in 1 hour. The Wassermann reaction was negative. Blood cholesterol was 105 milligrams per 100 cubic centimetres.

I wish to thank Sir Reginald Watson-Jones for permission to publish this case.

ON THE TENDON OF THE SUBCLAVIUS MUSCLE

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In a recent contribution Burrows (1951) has described an original technique for the operative repair of recurrent anterior dislocation of the sternal end of the clavicle. The technique involved tenodesis of the subclavius muscle, using the mobilised tendon in a functional replacement of the damaged costo-clavicular [rhomboid] ligament.

British anatomical text-books pay curiously scant attention to the constitution of the subclavius muscle, omitting in particular all reference to the prolongation of the tendon of origin along the muscle's inferior border. Surgeons desirous of adopting the Burrows technique may therefore welcome more detailed information as to the constancy, and the average extent, of this particular part of the subclavius tendon, which forms the reparative medium

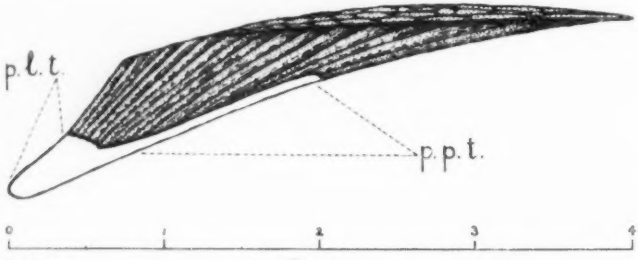

FIG. 1

Left subclavius muscle, isolated, showing the pars libera (*p.l.t.*) and the pars paramuscularis (*p.p.t.*) of the tendon. Scale in inches to indicate average anatomical proportions.

in that procedure. This note is based upon observations made in this department upon adult dissecting-room subjects of both sexes, upon the specially undertaken dissection of the subclavius muscle bilaterally in ten such subjects, and upon examination of fresh (unfixed) necropsy material. The range of specimens examined does not warrant any statistical presentation of findings but it affords a reliable picture of the constitution of the subclavius muscle sufficient for all practical purposes.

Both in fresh and in fixed cadaveric material it is easily and forcefully demonstrable that stability of the sterno-clavicular joint (more accurately, of the medial end, or "head," of the clavicle) depends fundamentally upon integrity of the costo-clavicular ligament and that, therefore, the replacement of this ligament by the mobilised subclavius tendon, is logically based.

Notwithstanding the obvious functional importance of the costo-clavicular ligament, its anatomy is either imperfectly or erroneously treated by British anatomists. The French anatomists, on the other hand, accord the ligament a greater (and more accurate) descriptive respect and are explicit concerning its role as the inferior ligament of the sterno-clavicular joint.

THE TENDON OF THE SUBCLAVIUS MUSCLE

The tendinous component of the subclavius muscle is essentially bipartite, comprising a shorter, stouter, medial, "free" part (*pars libera tendinis*) and a longer, thinner, more lateral

"attached" part (*pars paramuscularis tendinis*), the two parts being confluent medially in the "tendon of origin," but terminating laterally in differing fashion (Figs. 1 and 5). The former component, essentially the tendon of origin, is the commonly accepted "tendon" of British anatomists and the only tendinous element in the subclavius to receive the attention of Gray (1858), Thane (1882, 1894), Macalister (1889), Paterson (1902) and the successive editors of the more familiar anatomical treatises. The latter component, a prolongation of part of the tendon of origin, though ignored by the British, is fully recognised by the French anatomists, such as Testut (1889), Poirier (1896) and, after them, by the German Eisler (1912) and others. Thus Testut (1889) regarded the subclavius tendon as "*un fort tendon qui se prolonge le long du bord inférieur du muscle*," and in a later (1904) edition described the tendon as prolonged "*fort loin*" upon the muscle's lower border. Poirier (1896) described "*un tendon long et fort*" and prolonged upon this same border; and Eisler (1912) described the tendon of origin as being continued superficially upon the posterior and inferior aspects of the muscle. We have confirmed the accuracy of the observations, and have somewhat amplified the findings, of these Continental anatomists.

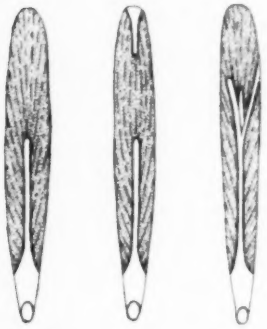

FIG. 2 FIG. 3 FIG. 4

Inferior aspect of subclavius muscle to show disposition and variations of pars paramuscularis tendinis. Figure 2—The commonest arrangement. Figure 3—Additional inferior tendinous slip at the lateral extremity of the muscle. Figure 4—The pars paramuscularis dividing into three fasciculi, the middle fasciculus becoming intramuscular.

Pars libera tendinis—This arises from the first costal cartilage or first costo-chondral junction as a stout, strong, rounded or cylindrical structure, about half an inch long, which passes upwards and laterally, partly to give rise to the shorter, more vertical and more medial fibres of the subclavius muscle and partly to become continuous with the pars paramuscularis. It is contiguous to, but never continuous with, the costo-clavicular ligament. In about 85 per cent of specimens it abuts against the outer aspect of that ligament and in 15 per cent it lies slightly anterior thereto. We have never found a bursa between the pars libera and either the costo-clavicular ligament or the first costal arch, though such bursae have been noted, as rare, by Koch (1789) and Rosenmüller (1828). Commonly there is some fascial continuity between the sheath of the subclavius muscle and the costo-clavicular ligament, and when such continuity is pronounced there results the illusory appearance of the origin of the pars libera from between the two layers of the costo-clavicular ligament. Very occasionally a small vein, uniting the cephalic with the subclavian, passes deeply between the pars libera and the costo-clavicular ligament.

FIG. 5

FIG. 6 FIG. 7

Details (diagrammatic) of the subclavius tendon. Figure 5—The entire tendon viewed anteriorly, the pars paramuscularis (*p. paramusc.*) dividing into inferior, middle or intramuscular and posterior fasciculi. Figure 6—Sagittal section to show gutter-like nature of pars paramuscularis. Figure 7—Sagittal section to show relation of tendinous fasciculi to muscle belly (stippled).

Pars paramuscularis tendinis—This is continuous medially with the pars libera (Figs. 1 and 5). It usually takes the form of a strong, narrow, flattened tendinous band, two to three millimetres wide, extending along the inferior free border of the subclavius for some 40 to 60 per cent of the muscle's length—that is, for a distance of from one to one and a half inches. It is invariably present and is usually confined to the medial moiety of the subclavius muscle, though occasionally it extends throughout the entire

length of the muscle belly. On parting from the pars libera, this paramuscular part of the tendon becomes rapidly trough- or gutter-shaped, with its concavity superiorly. From the floor of this tendinous gutter arise the intermediate and lateral muscle fibres of the subclavius, increasing somewhat in length and obliquity in their medio-lateral sequence of origin (Fig. 6).

The pars paramuscularis constitutes the sharpish, slightly arched inferior border of at least the medial half of the muscle—sometimes more. On tenodesis it yields, in conjunction with the pars libera, one and a half to two inches of stout, tendinous " thread ": when the pars paramuscularis is well developed, an even longer strip of such " thread " becomes available. From below, the pars paramuscularis appears as a narrow, glistening band, of almost uniform width, with a rounded lateral extremity (Fig. 2). In about one-fifth of specimens examined, however, its average length is exceeded and the complete tendon terminates by division into two or three (rarely more) " tails " or fasciculi (Figs. 4 and 5). Each of these fasciculi averages half an inch or more in length, and each gives origin to muscle fibres. There is some variation as to number and disposition of fasciculi. A common pattern (Figs. 5 and 7), however, is for three fasciculi to be present, thus: 1) an inferior, along the lower border of the muscle; 2) a middle or intramuscular; and 3) a posterior, extending superiorly on the posterior surface as far as the coraco-clavicular ligament. It is obvious that the presence of such fasciculi, being variable, cannot materially influence surgical considerations; nevertheless a well developed inferior fasciculus increases the length of tendinous " thread " mobilised by tenodesis of the subclavius muscle.

THE SUBCLAVIUS SHEATH

The fascial sheath (epimysium) of the subclavius, relatively thin generally, is somewhat thickened laterally. Part of the clavi-pectoral fascia, it is continuous medially, as already noted, with the costo-clavicular, and laterally with the coraco-clavicular, ligament. Anterior to the muscle belly the sheath exhibits a continuous series of curvilinear fibres, concave upwards and disposed at right angles to the subjacent muscle fibres, which converge as a recognisable arciform bundle upon the coracoid process as the upper component of the costo-coracoid membrane. The degree of development of these particular fibres is largely responsible for the presence or absence of a costo-coracoid " ligament " within that membrane. When exceptionally developed these fibres constitute the medial coraco-clavicular ligament of the French anatomists.

VARIATIONS OF THE SUBCLAVIUS MUSCLE

The known variations of the subclavius are listed by Le Double (1897) and Eisler (1912). Absence of the muscle is excessively rare, the trend of its variation being in the direction of duplicity, due essentially to anomalous differentiation of the primary pectoral muscle sheet. Such considerations are without practical application and may be ignored. The remarkable constancy of the subclavius muscle, the invariable presence of its pars paramuscularis tendinis, the possible presence of an inferior fasciculus—these are the points of significance in relation to tenodesis of the subclavius. A sufficiency of reparative material is invariably available for the successful execution of the Burrows procedure.

SUMMARY

1. The descriptive anatomy of the tendinous component of the subclavius muscle is amplified.

2. The subclavius tendon comprises a shorter, medial pars libera, continuous with a longer, narrower, more lateral pars paramuscularis. This last may be prolonged further laterally by two or three tendinous fasciculi.

3. Both parts of the subclavius tendon are constant. By tenodesis they provide, on the average, one and a half to two inches of material eminently suitable for employment in the functional replacement of a damaged costo-clavicular ligament.

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SPECIMENS FROM THE HUNTERIAN COLLECTION

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11. The Elbow Joint (Specimen S 14)

These two specimens are from the same subject. The cavity of the right elbow joint has been gently distended by an injection of green gelatin, while brown gelatin has been injected into the bursa alongside the biceps tendon. In both specimens the bones of the forearm are in supination.

Specimen S 14 (Medial view)

Medial view—In the left elbow (upper specimen) the capsule has been removed, and the three parts of the medial ligament are seen. Two bands diverge upwards from the coronoid process of the ulna to the medial epicondyle of the humerus and to the medial border of the olecranon, forming together a V-shaped mass. The gap of the "V" is bridged by the third part of the ligament, which lies more deeply; its fibres run transversely between the limbs of the "V." These fibres have a linear attachment to the humerus and the olecranon. The ulnar nerve lies upon them and, a little lower down, passes across the medial border of the coronoid process of the ulna.

In the right elbow (lower specimen) most of the fibres of the medial ligament have been

removed to expose the capsule of the elbow joint, to which the deep fibres of the medial ligament are rather firmly attached. The attachments of the capsule can be made out; they follow very closely the articular margins of the humerus and ulna. The capsule itself is thin and weak, contributing nothing to the strength or stability of the elbow joint.

The biceps tendon is flat at its insertion, where it is received into the posterior border of the tuberosity of the radius in the long axis of the limb. The bursa is of sufficient size to separate the biceps tendon from the bare area of the tuberosity of the radius. The bicipital aponeurosis [lacertus fibrosus] has been cut short; it is inserted, by way of the deep fascia of the forearm, into the posterior [subcutaneous] border of the ulna.

The fibres of the interosseous membrane slope downwards from the radius to the ulna, but fibres sloping in the opposite direction strengthen the free upper border of the membrane. The oblique cord is a slender structure; it can be seen sloping upwards from the

SPECIMEN S 14 (Lateral view)

lower border of the bicipital tuberosity of the radius to the coronoid process of the ulna. **Lateral view**—In the left elbow (upper specimen) the single lateral ligament can be seen fanning out from the lateral epicondyle of the humerus to the annular ligament which is, of course, not attached to the neck of the radius. The lower specimen shows that the synovial membrane is, however, firmly attached to the neck of the radius around the cylindrical articular margin, whence it decends a little over the neck of the radius before folding back on itself to ascend beneath the annular ligament and become attached to the humerus. Most of the annular ligament and lateral ligament have been removed for better exposure of the tenuous capsule and synovial membrane. The size of the bicipital bursa can be seen.

RETARDED CALLUS FORMATION IN RABBITS TREATED WITH SODIUM CITRATE

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Dixon (1951) recently gave a survey of our knowledge of the metabolism of citric acid and its association with that of calcium. Summing up, he wrote: " Precisely how all these observations fit into calcification mechanisms is not clear at present, but the function of citrate in bone certainly requires increased attention." It is strange that we have not focused more attention on the possible part played by citric acid in the physiology and pathology of bone. It is, however, known that the quantity of citric acid in bone is by no means negligible—according to Dickens (1941) it constitutes about 1 per cent of the dry substance—and that about 90 per cent of the body citrate is to be found in the skeleton. Citric acid also plays an important part in the metabolism of organic acids (Knoop and Martius 1936, Krebs *et al.* 1938) and it is active in the formation of amino-acids (Adler *et al.*, quoted by Martensson 1940) and in inorganic metabolism (Ostberg 1931, Sjöström 1937).

Judging from a perusal of the literature on the pathology of bone, the only reports available on the effect of citric acid on the skeleton are those presented by Letonoff and Kety (1943), who showed that citric acid is capable of mobilising lead stored in the bones; and those published by Gomori and Gulyas (1944), who observed that the injection of sodium citrate into puppies caused changes in the bone marrow similar to those produced by injections of toxic doses of parathormone.

It was thought that an investigation into the effect of citric acid on fracture healing might yield something of interest. A few preliminary experiments were therefore made in full-grown rabbits.

EXPERIMENTAL METHOD

A piece of the bone about 3 millimetres wide was resected from the middle of the fibula.* The anatomy and the ready accessibility of the fibula of the rabbit make the bone suitable for such studies; and the animals have full use of their limbs immediately after the operation. Furthermore, the technique permits a practically uniform resection in all the animals. A 4 per cent solution of sodium citrate was used as recommended by Gomori and Gulyas (1944). A quantity of 20 millilitres was injected subcutaneously and as a single dose once a day into animals 32, 33 and 35, while the remainder of the animals received 25 millilitres, divided into two doses daily at intervals of ten to twelve hours. The injections were continued for a week, the first injection being administered on the third day after the resection. From the tenth post-operative day radiographs were made of the fractures every seventh day. In order to obtain control material the animals were divided into two groups. In one group the experiments using citrate were carried out first and the fractures observed radiographically; about one month after the last radiograph had been made the opposite fibula was divided. During this second experiment the animals received no sodium citrate and the fracture served as a control. In the other group the order of the experiments was reversed; the control experiment was performed first and one month after the end of the experiment the other leg was resected and sodium citrate administered in the manner described.

In this way it was possible to study the effect of sodium citrate on the healing of a fracture and to compare the mode of healing with normal healing in the opposite leg of the

* Technical details of the method used in the study of callus formation are described by the writer in Acta Orthopaedica Scandinavica, **29**, 5, 1951.

same animal. All the animals were fed on a uniform diet, and in a few instances in which infection developed or in which the resection was technically unsatisfactory the animals were discarded.

RESULTS

The results given in Table I show that in nine of eleven cases the injection of sodium citrate retarded callus formation. In one instance (rabbit 36) no difference was observed, and in another (rabbit 42) the healing of the fracture in the control leg was slightly retarded. Callus formed after the administration of citrate showed no pathological features except in two rabbits (41 and 45) in which the ends of the fragments showed a more marked porosis than in the other animals.

TABLE I

RATE OF CALLUS FORMATION IN THE SIDE TREATED WITH SODIUM CITRATE AND IN THE CONTROL SIDE, AS SEEN RADIOGRAPHICALLY

Animal	10th day		17th day		24th day		30th day		38th day		Remarks
	Treated	Control	Treated	Control	Treated	Control	Treated	Control	Treated	Control	
32	0	+ -	0	+ + -	+ +	+ + +	+ + +	+ + +	+ + +		
33	0	0	0	(+)	0	+	0	-	0		No reaction seen in the side treated with sodium citrate
35	0	+	(+)	+	+ +	+ + +	+ + +	+ + +	+ + +		
36	?	+	-	+	+ + +	+ + +	+ + +	+ + +	+ + +		
40	0	0	0	0	0	+ +	+	+ + +			
41	0	0	0	0	0	+ + +					Slight porosis of the side treated with sodium citrate
42	0	0	0	0	+	0	+	+ + +	+ + +	+ + +	
43	0	0	0	+	+	+ + +	+ +	+ + +	+ + +		
44	0	0	0	-	0	+	+ +	+ +	+ + +	+ +	Callus but no bridging callus in the control side
45	0	0	0	0	0	+	0	+ + +	+	+ + +	Slight porosis of the side treated with sodium citrate
46	0	0	0	+	+	+ +	+ +		+ + +		Sudden death during experiment on the control side

DISCUSSION

Daily injection of sodium citrate for one week was found to retard healing of the experimental fractures in full-grown rabbits. Callus formation is in itself a complicated process, the mechanism of which is not yet clearly understood. The injection of sodium citrate meant the addition of a new factor affecting not only the salt balance but also the synthesis of amino-acids. The retardation of callus formation after the injection of sodium citrate may be tentatively explained in several ways. A discussion of some of the more important hypotheses follows.

Alkalosis—The administration of sodium citrate disturbs the acid-base equilibrium with excess of alkali (Ostberg 1931, Krusius 1940) and thereby possibly produces a shift towards an alkaline reaction. The change in the acid-base equilibrium increases the amount of reserve alkali. In order to form an idea of the degree of alkalosis the carbon dioxide tension of the blood was measured in two of the rabbits that had received 1 gramme of sodium citrate

daily for six days, and on the seventh day a specimen of the blood was drawn by heart puncture one, eight and twenty-four hours after the last injection. Control measurements were made at the same time in two untreated rabbits. The bicarbonate content was measured by the method of van Slyke. No difference was found between the treated and the control animals.

It is possible that the injected quantities were too small to produce any demonstrable—or at any rate more than very transient—change in the acid-base equilibrium. However, as no signs of protracted alkalosis could be demonstrated, this factor may be ruled out as a possible cause of delayed healing. In this connection it should be mentioned that Kubanyi (1930) observed a normal abundant callus formation in rabbits and in guinea-pigs that had been given sodium bicarbonate.

Biochemical changes in the ground substance—According to Martius (1938) and Adler *et al.* (quoted by Martensson 1940), citric acid plays an essential role in the synthesis of amino-acids. Therefore it does not sound unreasonable to suppose that the administration of sodium citrate in the present series disturbed the development of matrix. Osteoid tissue undergoes a biochemical transformation before calcium is laid down (Cartier 1947, Urist and McLean 1941, Habler 1930). If this process is disturbed, calcification will be impaired or the callus formed will be poor. An example of this may be seen in the poor healing of a fracture in the presence of hypovitaminosis C (Hertz 1935, Cartier 1947, Starr 1947, Wolbach and Howe 1925). This poor healing is attributed to immaturity of the collagen. Furthermore, Rhoads and Kasinskas (1942) showed in dogs that fracture healing is poor in the presence of hypoproteinaemia, and Harris *et al.* (quoted by Murray 1947) demonstrated that lysin deficiency will cause inadequate mineralisation of the bone. According to Cartier (1947) a proteinase (catheptase) forms in the bone marrow and this is believed to act upon the protein-matrix in the course of the above-mentioned biochemical transformation and upon the precipitation of lime salts. Martin's (1927) and Levander's (1940) observations also argue for the occurrence in the bone marrow of an enzyme favouring ossification. If, as shown by Gomori and Gulyas (1944) in experiments on dogs treated with sodium citrate, the bone marrow is completely or partly replaced by a fibrous marrow, it would not be unreasonable to suppose an inadequate amount of the enzyme and consequent impairment of callus formation.

Lime salts—Pincus, Peterson and Kramer (1926) showed that citric acid increases the solubility of calcium and that this increase is due to the formation of a complex. This complex is claimed to account for the non-ionisable calcium fraction of the blood serum. Alwall (1945) found that the injection of parathormone raises not only the level of the blood calcium but produces also a parallel rise in the serum citrate, and that the intravenous injection of calcium lactate and calcium chloride causes not only parallel increases in the calcium but also in the citrate concentration of the blood. Gomori and Gulyas (1944) and Chang and Freeman (1950) found in animals that the injection of sodium citrate and neutralised citric acid increased the citrate in the plasma and in the urine and increased the output of the calcium through the kidneys. Ostberg (1931) showed that acids and acidotic agents decreased urinary citric acid while the administration of alkali increased the urinary excretion of citric acid. He also assumed that citric acid is capable of retaining the calcium in the urine in solution by the formation of a complex compound, but he was unable to demonstrate any relation between calcium and citrate excretion in the urine.

Krusius (1940), who subjected various species of animals to tolerance tests, found increased urinary citric acid, but noted that the increase was not proportional to the amount of alkali given. He was unable to offer a satisfactory explanation for the discrepancy, but assumed an impairment of the citric acid metabolism or possibly a toxic effect on the dehydrating enzyme. According to Martensson's (1940) experimental investigation citric acid is broken down in the kidneys.

Inflammatory processes, post-operative conditions and thrombosis have been found to decrease the serum citrate (Scherstén 1936, Thunberg 1947, Sjöström 1937).

In the light of these considerations several possible explanations of the retarded healing suggest themselves. One might, for example, assume that the deposit of lime salts in the matrix is not optimal because they are retained in solution on account of their reaction with the citric acid to form a complex. For this purpose comparison of the total amount of calcium in the callus of animals treated with citric acid and of controls might be useful. Such a comparison should preferably be complemented with a similar measurement of the citrate content. But the measurement of these substances in bone is no easy matter (Thunberg 1947) and in view of the small quantities involved the results would be hardly reliable.

Retarded healing might also be attributed to increased urinary excretion (see Gomori and Gulyas 1944) with the result that the local concentration of the calcium (at the site of the fracture) is insufficient. Normal healing always causes a certain demineralisation of surrounding bone (Cohn 1919, Leriche and Jung 1938, Dallemagne 1941), and according to Roche (1939) this demineralisation is not limited to the neighbouring bone but occurs in the entire skeleton, though, of course, to a lesser degree. Downs and McKeown (quoted by Goisman and Compere 1938) found in experimental studies that consolidation is poorer and retarded in animals fed on a diet poor in calcium. Also Goisman and Compere observed that callus formation is poorer and the trabeculae thinner in osteoporotic rats. Murray (1947), however, asserted that osteoporotic bone healed promptly. That a deficiency of salts necessary for ossification delays calcification was shown by Urist and McLean (1941), who observed that calcium was deposited within twenty-four hours after the addition of an adequate amount of phosphorus to the diet of rats previously starved of this element.

In the present study no measurements were made of the calcium or phosphorus content of the serum or urine. It is therefore not possible to form an idea of the relation between the calcium and the phosphorus or of the quantities of calcium excreted with the urine. In a few cases the radiographs showed a more marked porosis of the ends of the fragments than in others. It is, however, very difficult to judge the degree of porosis from the radiographs, and it is known from earlier experiments on rabbits (Landoff 1942) that it is not possible radiographically to judge differences of less than 15 per cent with any degree of certainty.

CONCLUSIONS

The experiments showed that the administration of sodium citrate retards fracture healing. This is probably due to a change in the solubility of the calcium or to a relative calcium deficiency on account of the excretion in the urine, or to a combination of both factors. Other reasons cannot, however, be excluded, such as a biochemical effect on the ground substance or an enzyme deficiency.

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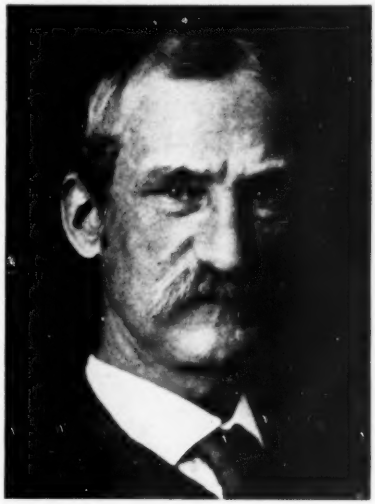
ARTHUR TRACY CABOT (1852-1912)

W. R. Bett, London, England

Born a century ago, on January 25, 1852, Arthur Tracy Cabot impressed his fellow surgeons, both in his own country and in other lands, by his versatility and by his soundness. Protégé of the great Henry J. Bigelow, and his heir in litholopaxy, he achieved international fame in the field of genito-urinary surgery. American orthopaedic surgeons associate his name with the posterior wire splint for fractures of the lower leg, which he devised while surgeon to the Children's Hospital at Boston and described in the *Boston Medical and Surgical Journal* (**110**, 6, 1884). Displacing the old fracture box, "Cabot's splint" retained its popularity for over thirty years and was one of America's standard splints during the 1914–18 war. The Chief Surgeon, H.Q. First Army, American Expeditionary Force, issued an order: "The Cabot posterior wire splint or wire ladder splint is to be used for all wounds of the calf, ankle and foot."



Many of Cabot's communications were made in the *Boston Medical and Surgical Journal*, covering such topics as osteoclasis, resection of the ankle joint, successful wiring of compound fracture of the patella, treatment of tuberculous bone disease, and removal of the arm with the scapula and greater part of the clavicle for sarcoma of the scapula. In a paper, "The surgical treatment of ankylosis of the temporo-maxillary articulation," published in *The Lancet* (**ii**, 304, 1897), he gave details of seven cases of his own, together with a review of the sixty-two cases previously reported in the literature.

After graduating at Harvard Medical School, Cabot continued his studies in Vienna, Berlin and London, where he heard Lister's inaugural lecture at King's College. He returned to Boston impressed with the importance of the pathological laboratory in the work of the surgeon, and fully appreciating the principles of antiseptic surgery. As early as 1876, the year of his graduation, he had succeeded in getting a "thoroughly aseptic result" in a compound fracture of the lower leg by using cotton batting which had been wrung out in a strong carbolic solution and allowed to dry. He and his brother Samuel made a generous donation towards the cost of a pathological laboratory at the Massachusetts General Hospital, as a memorial to their father, Dr Samuel Cabot.

Cabot was visiting surgeon to the Children's Hospital, Boston, from 1881 to 1889, surgeon to out-patients at the Massachusetts General Hospital from 1881 to 1886, and visiting surgeon from 1886 to 1907. As an operator he was careful and deliberate. Though not a brilliant teacher or speaker like his master Bigelow, he could impart knowledge with forceful brevity and clarity. His writings were remarkable for their economy and choice of words. Many people found him cold, austere, and even stern; others succeeded in winning a "rare but electrifying smile."

The portrait of Arthur Tracy Cabot is reproduced by kind permission of *Surgery, Gynecology and Obstetrics*.

Sir William Arbuthnot Lane

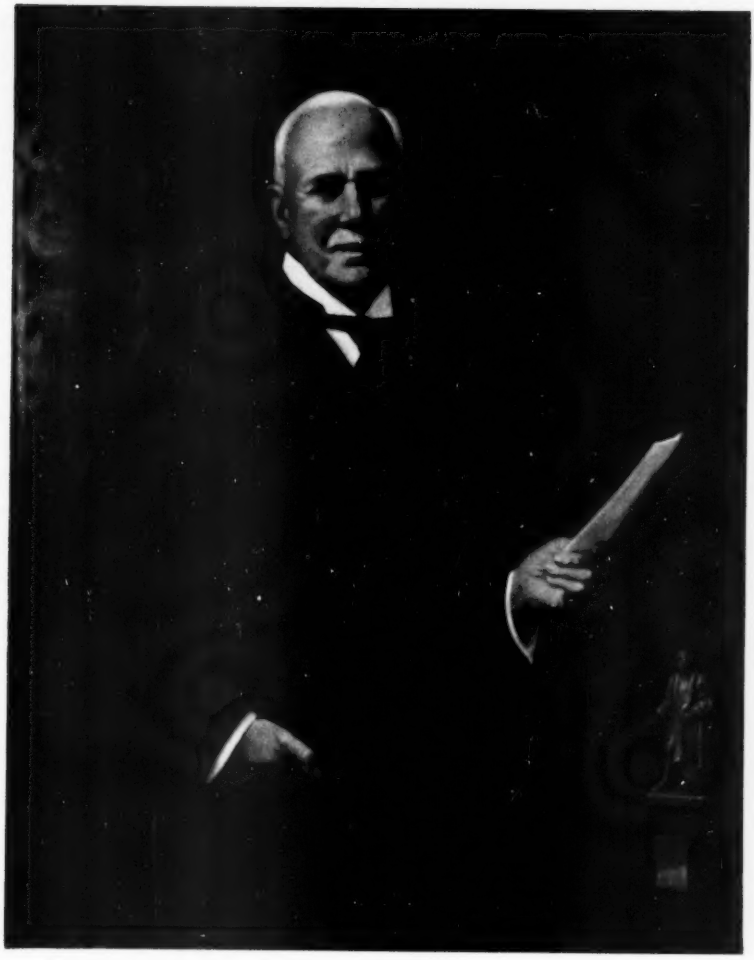
Sir William Arbuthnot Lane was a surgeon of surpassing operative dexterity and by his pioneer work has exerted great influence on bone surgery.

He was born on July 4, 1856, at Fort George, Inverness, being the eldest child of Benjamin Lane, a Brigade Surgeon who saw service in the Indian Mutiny. The boy's grandfather was William Lane, M.D., of Limavady, County Derry, Ireland. His mother, Caroline Arbuthnot Ewing, was the daughter of an Inspector General of Hospitals whose ancestors also derived from County Derry. At the age of twelve years, after much wandering abroad with his parents from one military station to another, he was sent to school at Stanley House, Bridge of Allan, a modest establishment but where he received an education for which he was always immensely grateful. His father feared his love of athletics but this did not prevent the boy from winning several school prizes and matriculating at Edinburgh University. On leaving school Lane decided to follow his forebears in the study of medicine and his father, being posted to Woolwich, entered him as a student at Guy's Hospital in October 1872 because it was near London Bridge station to which travelling from home was easy and inexpensive. He was only sixteen years old and looked even younger; his bearded and frock-coated fellow students began by tolerating his youthful appearance with an air of condescension; but they were soon to learn of his exceptional ability. Among his teachers were Addison, Gull, Samuel Wilkes and Pavy, men who left a permanent influence on medicine.

He qualified as a member of the Royal College of Surgeons in 1877 but was advised to take a London degree. This meant retracing his steps beginning with matriculation; he did so with gratifying results, being awarded the gold medal in anatomy at the intermediate examination and the gold medal in medicine at the final examination in 1881. The following year he became a Fellow of the Royal College of Surgeons and in 1883 proceeded to the degree of Master of Surgery. His first intention was to become a physician, for he had no particular taste for surgery, but at the time the prospect of election to the staff was much more promising on the surgical than the medical side; thereupon he decided for surgery. In those days teaching hospitals recruited their staff from the dissecting room; to Lane it was a good omen when he was appointed a demonstrator of anatomy in 1882, having Hale White, elected the previous year, as a colleague and with whom he lived in St Thomas's Street. In 1883 he was appointed Assistant Surgeon to the Hospital for Sick Children, Great Ormond Street, and in 1888, at the age of thirty-two years, he was elected Assistant Surgeon to Guy's Hospital.

During his six years' demonstrating in the dissecting room Lane conducted researches upon the function of the skeleton and its adaptation to stress and strain. He made an intense study of changes in bones, cartilages and joints due to occupational posture, pressure and strain of manual labourers. He stated: " To those who are unfamiliar with these changes, the variation from the normal is most striking and interesting, for the skeletons of many of the labourers differ from the usual type in a most remarkable manner. In other words, the form of the skeleton depends upon and varies with the mechanical relation of the individual to his surroundings." Amongst others he examined the skeletons of brewers' draymen, shoemakers, coal heavers and deal porters. He noted that in each of these occupations there was a peculiar bodily disposition during activity with many tendencies to skeletal change; the habitual assumption of this attitude eventually induced structural change. In the case of the brewers' drayman who carried a heavy barrel on his right shoulder the spine had become adapted to meet its burden. The upper thoracic vertebrae were deflected to the left

We are grateful to the Governors of Guy's Hospital, London, for permission to reproduce the portrait of Sir William Arbuthnot Lane.—Editor



William Arbuthnot Lane
1856-1943

side so there had been greater strain imposed on the intervertebral joints of the left than on those of the right side. This unequal stress was plainly manifest by well marked beak-like lipping of some of the vertebrae on their left side. Lane considered these osseous changes to be an adaptive reaction designed to broaden the surfaces of the vertebrae to meet the unusual occupational stress. This was certainly an original interpretation of the pathological changes occurring in the vertebrae; the fact that only a few vertebrae were affected and those at the site of greatest strain lent some support for this view—what Lane called "crystallisation of the lines of force." Most observers would probably say that the changes were those of a localised spondylitis of traumatic origin. That view, however, seems less illuminating than Lane's interpretation of the change as an adaptation to function.

In 1889 he began writing a series of papers on middle ear disease. He described the antrum and its functions, at the same time pointing out how inadequate, in suppurative otitis media, was the drainage provided by the prevailing method of perforating the mastoid process with a small trephine. Lane was the first surgeon in this country to open and explore the mastoid antrum, employing specially devised gouges and chisels for the purpose.

Soon after his appointment to the Hospital for Sick Children he introduced the startling innovation of rib resection for empyema drainage. Ambroise Paré had performed the same operation but it was forgotten. Lane, reporting the procedure, wrote: "I found many cases of empyema which had been treated in the usual way by aspiration, followed if necessary by intercostal incision and drainage, both of which are not infrequently totally inadequate. To meet this difficulty, after determining the lower limit of the pus-containing cavity, I removed a sufficient length of a rib to permit of free access and perfect drainage. In the aperture so made, a tube of considerable calibre could be fastened so that its internal opening was flush with the pleura. Through such an opening it was readily possible to open and drain a pericardium filled with pus. By such active and efficient means these cases of empyema recovered rapidly and thoroughly."

In 1905 Lane published a book on Cleft Palate and Hare-lip which went to three editions. He advocated repair of hare-lip soon after birth so that a cleft palate might be closed earlier than was customary, in order to enable the face and jaw to develop normally and the naso-pharynx to function properly. He closed the palatal cleft with a flap of mucous membrane and periosteum. This provided a complete partition between nose and mouth but the new soft palate was often too rigid to play an efficient part in speech. The operation has long since been superseded by the procedures of plastic surgery whereby there is secured a mobile lip, by the use of skin grafts, and a long freely movable soft palate. Early closure of hare-lip is still preferred.

In 1909 Lane excised a carcinoma of the cervical oesophagus; the gap was repaired by skin flaps from the neck. This operation was something of a landmark in surgery. It was said to have inspired Wilfred Trotter in his planning of similar operations for excision of carcinomata of the pharynx.

In the later period of his hospital career Lane devoted much attention to the consideration of alimentary toxaemia. He maintained that the assumption of the erect attitude favoured downward displacement of the viscera, to prevent which peritoneal bands were developed. These bands produced kinks of the bowel at various points and so led to chronic intestinal stasis, thereby facilitating infection of the upper alimentary tract. This toxaemia was said to be responsible for a large number of ailments such as duodenal ulcer, pancreatitis, cholangitis, goitre, cardiac and renal degeneration; furthermore, patients with intestinal stasis readily developed tuberculosis and rheumatoid arthritis. Holding the view that the toxaemia causing these diseases was due to the obstructive action of the colon, he embarked on extensive colectomy for their cure. Intestinal stasis and Lane's remedy for it aroused a good deal of controversy. A discussion at the Royal Society of Medicine, extending over six meetings, took place in 1913. Lane was quite definite in his affirmations as to the fact

of intestinal stasis and its cure by colectomy. The evidence however was not sufficiently convincing; there were no follow-up reports submitted to prove the permanent value of so drastic a procedure. The operation never got a foothold; it gradually faded out.

INTERNAL SPLINTING OF FRACTURES

Lane's early researches on skeletal function led him on to study restoration of function in skeletal injury and disease. He declared that a fracture which had healed with its fragments displaced induced an alteration in the mode of pressure transmission to other bones, accompanied by potential articular changes. He was profoundly dissatisfied with the poor level of attainment reached in fracture treatment generally. He attributed much of this unsatisfactory state to the lack of intelligent interest in fractures, particularly in adhering to traditional splints that failed of their purpose. It was in 1883 that Lane began writing on fractures and after the experience of a decade in their handling he had reached the conclusion that for the intractable fracture open reduction with rigid fixation was necessary. This decision started an epoch, for the rigid internal splint has had an application in orthopaedic surgery beyond the dream of its originator. It is well therefore to give the *ipsissima verba* of its introduction to the Clinical Society of London on April 13, 1894.

"My experience of the usual methods of treating simple oblique fractures of the tibia and fibula in certain classes of labouring men, by manipulation of the fragments and the subsequent retention of the limb in some form of splint is that the results so obtained are but too frequently unsatisfactory in the extreme. This conclusion has not been arrived at from the examination of a small number of cases, but I have collected and observed many at varying intervals of time after the injury and have inquired fully into their condition. . . . I have no hesitation whatever in asserting that, under the methods of treatment at present adopted, not only is the man totally incapacitated from earning a living for an unnecessarily long period, but in a considerable proportion of cases he is unable subsequently to perform such heavy work as he was able to do before the injury, so that he is obliged to follow some less remunerative pursuit, if indeed he has not to depend solely on charity.

"If what I state is true, the form of treatment of such fractures which is universally adopted in our hospitals is simply disastrous and can only be perpetuated because we are unaware of the financial loss or even ruin which our very imperfect surgical methods entail on our unfortunate patients. Though the shortening and deformity are usually trifling, the somewhat complicated displacement of the ends of the fragments on one another is sufficient to completely alter, and often irretrievably damage, the machinery of the lower extremity. The deviation of the axes of the lower fragments of the tibia and fibula from the directions they originally occupied when in continuity with the upper portions of the respective bones causes pressure to be transmitted through the joints of the ankle and foot, of the knee, and to some extent of the hip, in such an abnormal manner that the individual experiences not only a feeling of insecurity in these joints, which is especially marked in the foot and ankle, but he also suffers from progressively increasing pain and discomfort. This means that the anatomy of the several joints which are called upon to perform a function other than that they were accustomed to carry out must alter in consequence of, and in proportion to, the degree in which the directions of the lines of pressure which are transmitted through the joints are changed. Under these altered circumstances the joints are unable to carry out their physiological functions with the same accuracy and perfection that they did previous to the accident, and this inability is a progressive one, and is accompanied by pain and discomfort which increases rapidly, and is most marked in those who sustain such fractures when past middle age. . . .

". . . Why should we hesitate for one moment to bring commonsense mechanical principles to bear in the case of simple fractures of the tibia and fibula, when most surgeons of the present day would not dream of doing otherwise in the case of fracture of the patella with separation of the fragments? . . . Now as regards the best means of fixation of the

fragments; in my earlier cases I used silver wire, but soon gave it up . . . One frequently found that no amount of traction upon the ends of the wires could retain the surfaces in accurate apposition after the grip of the lion forceps was relaxed. Therefore I decided to treat the bones as one would the broken leg of a table or chair. The surfaces were brought into accurate apposition, and kept in their normal relationship by lion forceps. Holes were drilled above and below the forceps and screws were driven in. The screws could be passed in any direction, and they retained the surfaces in an apposition more accurate and more forcible than I fancy can be attained by any other mechanical arrangement."

On January 8, 1894, Lane operated upon a man aged thirty-four years with oblique fractures of tibia and fibula, inserting binding screws. " The fracture in the tibia was exposed by an incision 4½ inches long when its direction was seen to be very oblique, running downwards, outwards and backwards. Several small fragments of bone and muscle intervened between the ends of the bones.

" Another effort to reduce the fragments by manipulation and traction was made, and the result was observed through the incision, when it was quite obvious that it could not have been effectual in this case in producing anything like apposition. The fragments of bone and the muscle which intervened were removed, and after much difficulty the broken surfaces were brought into accurate apposition by means of lion forceps, and two screws were inserted."

Lister in 1877 with antiseptic precautions wired a fractured patella, obtaining osseous union, a result rarely obtained by external splinting. Notwithstanding the success of the operation he was submitted to some unfavourable criticism for this " unjustifiable procedure." Lane persisted with the operative treatment of fractures; in an ununited fracture of the neck of the femur he obtained osseous union by passing two long screws from the greater trochanter, through the neck into the femoral head, thereby anticipating the later nailing operation. It was some time after 1905 that he introduced his well known steel plates and screws; with these he extended the range of fracture operations. But his operating on simple fractures raised a storm of criticism and even abuse. In his hands the operation was performed under strict asepsis but some other surgeons less meticulous in their technique failed to obtain union of the fracture owing to sepsis. This led to a tendency to blame the operation rather than the manner in which it was performed.

NO-TOUCH TECHNIQUE

Lane soon realised that if the operative treatment of fractures was to be safe a rigorous aseptic technique was essential. The skin over a wide area was prepared several hours before the operation; on the table the part was painted with a solution of iodine. The operation area was surrounded by a generous supply of sterile mackintoshes clipped to the skin. All instruments after sterilising were kept dry. The knife used for incising the skin was discarded and a fresh knife employed in the wound. Towels covering the skin were clipped over the edges of the wound because the exposed raw edge was considered a greater danger than the prepared skin. The theatre sister held an instrument with forceps when handing it to the operator and she threaded needles with the aid of two pairs of forceps. To facilitate reduction and control of the fracture Lane devised pairs of powerful bone forceps with long handles which kept the hands well away from the wound. No part of an instrument which entered the wound was allowed to touch the surgeon's hand. All ligaturing and sewing were done with the aid of needle holder and forceps. This scrupulous no-touch technique was a by-product of Lane's fracture work but it has had a transforming effect on operative orthopaedic surgery.

Lane retired from the active staff of Guy's in 1920 but continued to practise from his house at 21 Cavendish Square. He turned his attention to educating the public in healthy living, for he maintained that disease was due to defective diet and bad habits. In 1926 he

founded the New Health Society to teach the public the simple laws of health; to aim at rendering fruit and vegetables more accessible to the housewife and at reasonable cost; to relieve overcrowding by promoting a return of the people to the land. The campaign involved Press and platform propaganda which brought him into conflict with established authority although several members of the profession supported the movement. The Society was largely responsible for founding a chair of dietetics at London University.

In 1908 Lane was elected to the council of the Royal College of Surgeons; he served for eight years. He was invited to deliver the Murphy oration and when he arrived in America to do so he was given a tumultuous welcome. He was elected a Fellow of the American College of Surgeons. In 1913 Lane was made a baronet; some years later he became a Companion of the Bath and a Chevalier de la Légion d'Honneur. He died on January 16, 1943, in his eighty-seventh year.

In appearance he was tall and slim with a distinguished bearing; his face pale, strong and handsome with the head slightly inclined to the right. He spoke with a soft, quiet voice. He was twice married, first in 1884 to Charlotte, daughter of John Briscoe, with whom he celebrated his golden wedding, and in 1935 to Jane, daughter of N. Mutch. He had a son and three daughters, two of whom married members of the staff of Guy's Hospital and the other achieved distinction as an educationist.

Arbuthnot Lane was a man of great originality of ideas and a superb surgical craftsman. He took a leading part in the advance of surgery soon after the antiseptic system was established. He was one of the first to proceed from the antiseptic method of operating to that of asepsis. And he actually pioneered the perfection of aseptic surgery by introducing the no-touch technique. This last way of operating and his metallic internal splint have had a profound influence upon bone and joint surgery.

He fascinated his assistants by his extraordinary dexterity and imbued them with enthusiasm for surgery. The original of the portrait, accompanying this narrative, was presented to Guy's Hospital in 1931 by Arbuthnot Lane's house surgeons, who served under him over a period of thirty years, as a mark of affection for their Chief.

ARTHUR ROCYN JONES.

I gratefully acknowledge the great help received in reading the biography of Sir W. Arbuthnot Lane by one of his able assistants, Mr W. E. Tanner.

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PROCEEDINGS AND REPORTS OF UNIVERSITIES, COLLEGES, COUNCILS AND ASSOCIATIONS

GREAT BRITAIN

JOINT MEETING OF ORTHOPAEDIC ASSOCIATIONS OF THE ENGLISH-SPEAKING WORLD—JULY 1952

For the first time in history every Orthopaedic Association of the English-speaking World has joined in a combined Annual Meeting. It was a memorable occasion, held in the last few days of June and the first fortright of July, in London and many of the provincial centres of England, Wales and Scotland. Six hundred and fifty surgeons, who with their wives totalled well over one thousand, met from the United States, Great Britain, Canada, Australia, New Zealand, South Africa and the Philippines, together with representatives from France, Belgium, Holland, Denmark, Sweden, Finland, Italy, Portugal, Brazil and Argentina—the Corresponding Editors of this Journal.

Her Majesty Queen Elizabeth the Queen Mother receiving a bouquet from Penelope Newman. *On the left*—Her Royal Highness Princess Alice and Major-General the Earl of Athlone, Chancellor of the University of London. *On the right*—President of the British Orthopaedic Association.

The scientific meetings were in the Senate House of the University of London. At the Inaugural Ceremony on Monday, June 30, Her Majesty Queen Elizabeth the Queen Mother, attending her first official engagement for many months—the first since the death of His late Majesty—added sympathy and understanding to a dignified occasion with its sense of tradition, its rich colour of academic robes and gold maces, and its deep warmth of feeling.

Throughout the week there was a continuous display of cinematograph films of surgical, pathological and anatomical interest, as well as displays of surgical instruments, appliances, books and publications. The first clinical meeting, planned with impressive skill at the Country Branch of the Royal National Orthopaedic Hospital, proved that even at meetings of from five hundred to one thousand surgeons it need not be assumed that academic presentation alone is

possible, but that bedside discussion and clinical examination can be arranged profitably even for such large numbers. On another afternoon, clinical demonstrations of a more intimate character for smaller groups of surgeons were arranged in the medical schools of most of the London teaching hospitals.

The London part of the meeting ended on Saturday, July 5, with visits to the Plastic and Facio-Maxillary Hospital at East Grinstead, the Royal Air Force Rehabilitation Centre at Headley Court, the Heritage at Chailey, Canterbury, Black Notley, and the United States Air Force Hospital at Swindon. Thereafter a week was spent in hospital and ward visits, clinical meetings and friendly debates and discussions in many of the orthopaedic centres of England, Wales and Scotland. For example, in Liverpool there was a debate on the proposal " That in the treatment of fractures, operative internal fixation will replace external splintage " and in the home of conservative surgery the motion was carried by a slight majority—though whether in acknowledgment of firm convictions or in appreciation of debating merit is not yet certain. Thereafter at an impressive ceremony on the site of the ruins of 11 Nelson Street, Mr Esmond West, representing the Australian Orthopaedic Association, unveiled a memorial plaque to Hugh Owen Thomas, Robert Jones and T. P. McMurray. In Edinburgh an energetic clinical programme was followed by a reception in the Royal College of Surgeons of Edinburgh, and the Castle was specially floodlit for the occasion. The meeting at Norwich was graced by the presence of H.R.H. Princess Margaret. At Exeter a full clinical programme was mingled with Mayoral receptions and sightseeing; and the clinical work at Bath, Bristol, Birmingham and Oxford was lightened by visits to the Stratford Memorial Theatre. Work at the Robert Jones and Agnes Hunt Orthopaedic Hospital was relieved by visits to the Border Castles and Chester, even if the visitors did not get to the International Eisteddfod in Wales as they should have done—and then in the Lake District where Mrs Furlong was host.

Her Royal Highness Princess Alice receiving a bouquet from Tanja Osmond-Clarke.

The joint conference was no doubt an evidence of historical and traditional development. There had been previous combined meetings of English-speaking surgeons of more limited scope. Soon after the first world war, American and British orthopaedic surgeons met in London under the presidency of Robert Jones. Three years after the second war there was a joint American-Canadian-British meeting in Quebec. This recent meeting, wider and more representative than those preceding it, needed no war for its encouragement and stimulation. It was a meeting of all English-speaking orthopaedic surgeons, including many who to their credit and our respect speak not only their own language but ours as well.

The feature of the second joint meeting held in Quebec was the important contribution made by younger surgeons, who have since formed the A.B.C. Club of America, Britain and Canada. In the recent meeting yet another endeavour was made to encourage younger surgeons and it will be noted in the scientific programme how few papers were presented by senior fellows from Great Britain. In this country there was a little criticism of this decision but most believe that it was right, although of course the academic standard is still to be judged in the papers to be published in the Journal.

There is one other feature of the recent meeting, again planned deliberately, to which reference may be made. Seldom before was the distinction between the written and spoken word displayed more clearly. There was hardly one single laborious reading of typescript to a dull and weary audience. The presentations were brisk and bright; the gong was seldom needed—and when it was needed, it was used relentlessly; there was quick repartee, rapier criticism, happy indulgence and alert exchange of wit. This surely is the secret of success of scientific conferences; the reports will be published in due course, and that is the time for detailed study and reading word by word. Why then should there also be detailed hearing word by word from which, as a matter of fact,

few can profit? Whatever the late judgment may be as to academic success, the scientific programmes were stimulating and sometimes inspiring.

It was a bitter-sweet blend that went to the preparation of this meeting—the bitterness of work too hard for some and of occasional disappointment and rebuff, and the sweetness of success in the scientific meetings, clinical conferences, happy parties and recreations, and the cementing of friendships not only between British hosts and guests but between the British hosts themselves. As to friendships between hosts and guests, one of several hundred letters received since the meeting may be quoted. A young surgeon from Yorkshire, trying in enthusiastic appreciation to find the greatest highlight of the meeting, suddenly recalled it: "I know what it was: I met a young American orthopaedic surgeon and his wife, and they are coming to stay with us next week to see how ordinary people live and work in this country." This is the success for which many had hoped.

But no less important was the cementing of friendships between the hosts themselves. Certainly fellows and members of the British Orthopaedic Association have never been more happy; and there is good authority for believing that whereas many Ladies Committees are charged with gunpowder, the longer our wives worked together the happier they were. Members of the American, Canadian, Australian, New Zealand and South African Orthopaedic Associations do not know how grateful are the members of the British Orthopaedic Association for the privilege they have been given in recent weeks.

INAUGURAL CEREMONY

After Her Royal Highness Princess Alice had received a bouquet from Tanja Osmond-Clarke, Major-General the Earl of Athlone Chancellor of the University, H.R.H. Princess Alice, Dr Bellot Vice-Chancellor of the University, Dr Logan the Principal, and Sir Reginald and Lady Watson-Jones received H.M. Queen Elizabeth the Queen Mother at the West Entrance of the University. In the Chancellor's Vestibule a bouquet was given to Her Majesty by Penelope Newman, who made a sweet curtsey and then wondered why the bouquet was not given back to her because that was what always had happened in practice with her mother! A nurse was then presented to Her Majesty. Meanwhile the halls of the University surrounding the Ceremonial Steps—the William Beveridge Hall, Macmillan Hall, Chancellor's Hall, Assembly Hall, as well as the balconies themselves—were thronged and filled; there was eager anticipation. The string orchestra from the band of the Grenadier Guards played from the balconies.

Official presentations were made to Her Majesty, who was wearing the gown of the honorary degree of Doctor of Laws of the University of London: the High Commissioners of the British Commonwealth, a representative of the American Ambassador, Ministers of the Crown, presidents of the several Royal Colleges of Physicians and Surgeons of Great Britain and Ireland, presidents of distinguished societies related to orthopaedic surgery, and other distinguished guests. While these presentations were being made the first procession of higher officers of all the Orthopaedic Associations in academic dress was filing into Beveridge Hall; the second procession followed after a slight pause; and finally the Royal Procession.

ORDER OF PROCESSION

Mr Attenborough (Bedell) Mr McNeur (Bedell)
Dr J. Naden, Scientific Secretary, Canadian Orthopaedic Association
Mr J. I. P. James, Scientific Secretary, British Orthopaedic Association
Dr Walter P. Blount, Scientific Secretary, American Orthopaedic Association
Mr W. T. Ross, Secretary, South African Orthopaedic Association
Mr Kennedy Elliott, Secretary, New Zealand Orthopaedic Association
Dr Alexander Gibson, Secretary, Canadian Orthopaedic Association
Dr H. Page Mauck, Treasurer, American Orthopaedic Association
Mr P. H. Newman, Secretary, British Orthopaedic Association
Dr C. Leslie Mitchell, Secretary, American Orthopaedic Association
Mr V. H. Ellis, Treasurer, British Orthopaedic Association
Professor O. Scaglietti, Corresponding Editor for Italy
Dr Arnaldo Ródo, Corresponding Editor for Portugal
Dr José Valls, Corresponding Editor for the Argentine
Dr Godoy Moreira, Corresponding Editor for Brazil
Dr Johannes Mortens, Corresponding Editor for Denmark
Professor Sten Friberg, Corresponding Editor for Sweden
Professor K. E. Kallio, Corresponding Editor for Finland

Professor Merle D'Aubigné, Corresponding Editor for France
Dr J. D. Mulder, Corresponding Editor for the Netherlands
Dr William Rogers, Editor-in-Chief of the *Journal of Bone and Joint Surgery*
Mr H. Guy Drew, President, Society of Surgical Instrument Makers
Mr R. Sharp, Vice-President, Society of Occupational Therapists
Mr J. H. Hanby, President, Chartered Society of Chiropodists
Mr Philip Wiles, President, Section of Orthopaedics, Royal Society of Medicine
Professor Whillis, Vice-President, Chartered Society of Physiotherapists
Mr A. D. Marston, Dean, Faculty of Anaesthetists
Dr Peter Kerley, President, Faculty of Radiologists
Dr Sven Kiaer, President of the Orthopaedic Association of Denmark
Dr W. C. Meiss, President of the Orthopaedic Association of the Netherlands
Mr C. Gordon Irwin, Vice-President, British Orthopaedic Association
Mr K. E. Kemp, The Master, Barbers' Company

Mr Golding (Bedell)

Sir Gordon Gordon-Taylor
Dame Georgiana Buller
Sir Arthur Sims
Mr P. H. Mitchiner, Deputy Vice-Chancellor of the University of London
Dr Logan, Principal of the University of London

Mr Shelswell (Bedell)

Sir Francis Fraser, Director, British Postgraduate Medical Federation
Sir John Charles, Chief Medical Officer of Health
Sir Henry Dale, President of the British Council
Lord Sempill, President of the British Council for Rehabilitation
Sir Geoffrey Peto, Vice-Chairman of the Central Council for the Care of Cripples
Sir Harry Platt, President of the International Society of Orthopaedic Surgery
Lord Webb-Johnson, President of the Royal Society of Medicine
Mr G. T. du Toit, President of the South African Orthopaedic Association
Mr Alexander Gillies, President of the New Zealand Orthopaedic Association
Mr Esmond F. West, President of the Australian Orthopaedic Association
Dr R. Graham Huckell, President of the Canadian Orthopaedic Association
Dr Fremont Chandler, President of the American Orthopaedic Association

Mr Carr (Bedell)

Dr G. Roche Lynch, The Master, Society of Apothecaries
Mr M. P. Burke, President of the Royal College of Surgeons in Ireland
Mr W. W. Galbraith, President of the Royal Faculty of Physicians and Surgeons of Glasgow
Professor W. Mercer, President of the Royal College of Surgeons of Edinburgh
Sir Cecil Wakeley, Bt., President of the Royal College of Surgeons of England
Sir Russell Brain, President of the Royal College of Physicians
The Right Hon. Iain Macleod, Minister of Health
Marquess of Salisbury, Minister for Commonwealth Relations
Dr Hans Clarke, Representative, American Ambassador
Mr Frederic Hudd, Deputy High Commissioner for Canada
Mr C. H. Torrance, Acting High Commissioner for South Africa
The Hon. F. W. Doidge, High Commissioner for New Zealand
Sir Thomas White, High Commissioner for Australia

ROYAL PROCESSION

Esquire Bedell

Professor Bellot, Vice-Chancellor of the University of London

Lord Woolton, Lord President of the Council

Sir Reginald Watson-Jones, President of the British Orthopaedic Association

H.R.H. Princess Alice, Countess of Athlone

The Right Hon. the Earl of Athlone, Chancellor of the University of London

Her Majesty Queen Elizabeth the Queen Mother

INAUGURAL CEREMONY—UNIVERSITY OF LONDON

Centre platform—Lord Woolton, Lord President of Council; Her Majesty Queen Elizabeth the Queen Mother; president British Orthopaedic Association (standing); Her Royal Highness Princess Alice; Major-General the Earl of Athlone, Chancellor of University.

Behind—Philip Newman, Secretary British Orthopaedic Association; P. Mitchiner, Deputy Vice-Chancellor; Lady in Waiting; Private Secretary to Her Majesty; Professor Bellot, Vice-Chancellor of the University.

To the left—High Commissioners of the Commonwealth and representative of the American Ambassador. *Further left*—the Presidents of the Royal Colleges of Physicians and Surgeons in Great Britain; *in front of them*—Editor-in-Chief of the Journal and Corresponding Editors.

The Chancellor of the University of London, Major-General the Earl of Athlone, welcomed the Orthopaedic Associations of the British Commonwealth and United States of America to the University of London.

Sir Reginald Watson-Jones, President of the British Orthopaedic Association, said: "Your Majesty, Your Royal Highness, Chancellor, Your Excellencies, My Lords, Presidents, Fellows, Ladies and Gentlemen—The history of orthopaedic surgery can be traced through many generations; in its more vigorous development through many hundreds of years; and in its more provocative development through many decades; and yet to-day we are witnessing an event of great importance in the history of orthopaedic surgery—the first joint meeting of all orthopaedic surgeons of the English-speaking world. This is not an international meeting, but in some respects it may be even more important than an international meeting. Few can doubt that the peace and quietude of the world depends upon the collaboration of English-speaking nations who bear a heavy responsibility; and none can doubt how great a contribution to that responsibility and that opportunity can be made by those of us who are surgeons, scientists, philosophers and friends.

"We deeply appreciate the honour that Her Majesty Queen Elizabeth the Queen Mother has conferred upon us, and you who have warm understanding will know what I mean when I remind you that this is the very first public engagement accepted by Her Majesty since the death of His late Majesty King George, who identified himself so closely with our work, and for very many years gave Royal encouragement not only to the development of Orthopaedic and Accident Services and Fracture Clinics in this country but to the collaboration and joint endeavour of surgeons of the British Commonwealth of Nations and the United States of America in our meetings and in our Journal.

"We are proud to have received a telegram from Her Majesty the Queen: 'I send my sincere thanks to you and orthopaedic surgeons of the British Commonwealth and Empire and of the United States of America for kind messages of good wishes sent on their behalf—Elizabeth R.'

"We have also a telegram from the Prime Minister, Mr Winston Churchill: 'Best wishes for the success of your joint meeting. It is a notable occasion which has brought together for the first time the orthopaedic surgeons of the English-speaking world. Yours is indeed a noble task to bring joy and hope to crippled children and to restore to a life of fruitful activity men who have been crippled by war or by the misfortunes of industry—Winston S. Churchill.'

"We have telegrams from every Prime Minister of the Commonwealth. I must read this message from Mr St Laurent from Ottawa: 'This meeting is another example of that friendly desire of members of the Commonwealth and the United States to co-operate in seeking the solutions to common problems and I sincerely hope that it will meet with success—Louis S. St Laurent.'

"I would like also to read the greater part of a telegram from our fellow surgeon, the Prime Minister of Southern Rhodesia; it is one that you must think about: 'When orthopaedic surgeons restore disabled men and women they are working in conformity with the basic principle which underlies the fabric of all countries of the English-speaking world, which is the sanctity of the individual. We now have a crippled and disabled world which can only be cured by the application of this spirit of humanity exemplified in the English-speaking countries, the practical application of which will be greatly helped by the co-operative work of your conference—Godfrey Huggins, Prime Minister.'

"On behalf of the Australian Government and people Mr Menzies has telegraphed: 'May your discussions advance yet another stage the noble work you are doing in the cause of all mankind.'

"Finally I must read part of a telegram from Sir Basil Brooke, Prime Minister of Northern Ireland: 'Suffering humanity has cause to bless orthopaedic surgeons for their wonderful skill and devotion of which we in Northern Ireland have abundant experience. The personal interest of Her Majesty Queen Elizabeth the Queen Mother in this noble work is valued by us all—Basil Brooke, Prime Minister.'

"The presidential jewels which Her Majesty has graciously agreed to present to each visiting president have as their common theme the crooked tree of Andry being made straight. The British jewel of office has incorporated within it the recent Royal Grant of Arms to the British Orthopaedic Association including the motto, *Recte*. The word means not only straightly but uprightly; it implies straightness not only in a physical sense but in a moral sense. In a free translation it means beautiful, befitting; proper, appropriate; noble, good.

"In being thus reminded of the Hippocratic oath may we to-day, with the kind and gracious support of Queen Elizabeth the Queen Mother, dedicate our work of making straight—of making straight the minds as well as the bodies of men—and may we dedicate it to be beautiful, noble and good."

SPEECH BY QUEEN ELIZABETH THE QUEEN MOTHER

Her Majesty rose and said: "I thank you most warmly for the welcome you have given me to-day. I am delighted to be able to be present at this gathering of orthopaedic surgeons, for the first time assembled in London from every part of the English-speaking world.

"There should indeed be no frontiers between nations in the common humanity of healing, for there exists but the measure of man's need. So I am especially glad to join with the Chancellor of London University in welcoming to-day so many representatives from the United States of America, from Canada, Australia, New Zealand and South Africa.

"Yours is indeed a noble profession. The Greek words *orthos* and *pais* mean a straight child so that orthopaedy provides an excellent description of your aims and ideals, for children have been from the earliest times the object of your care. Your endeavours, and those of your predecessors, have brought a new hope and joy to countless homes.

"In former years, infants so seriously handicapped that they were unable to stand, walk or even sit, and could only lie in bed in their misery, were hidden away in remote hamlets because it was thought that their deformities were a visitation to be concealed.

"Through your country-wide clinics and the great army of voluntary workers who have assisted you, these children whose physical misfortunes once condemned them to isolation and reproach are now treated in open-air hospitals and at the same time are educated and trained. Many have passed their school-leaving certificate and even matriculated to universities from hospital beds.

"This is perhaps your greatest contribution. You have restored disabled children physically

and at the same time enabled them to lead a full life, to be educated and trained, and to know how to laugh and be happy.

"To-day, however, the scope of your work has widened until it embraces not only the care of children but of grown men and women in all walks of life. The vast field of orthopaedic surgery now covers all that has to do with standing and walking, with playing and with working. It is your task to mend broken limbs and bones and nerves; to unloose the chains of arthritis and paralysis; and to study particularly the measures of treatment, often not surgical at all, which include the rehabilitation of the convalescent. It is by this service that those who are disabled may take their place again in the life of the community and be restored to the joys of recreation and the responsibilities of work.

"In your deliberations at London University you will, I know, be planning new ventures and looking to the great tasks which still lie ahead. But you may well take pride in the great names which have gone before you: the names of Hugh Owen Thomas and Robert Jones of England; of Newton Shaffer, Edward Bradford, John Ridlon, Royal Whitman, Robert Lovett and many others of the United States of America; and of very many pioneers in the British Empire who together have brought renown to this great field of reconstructive surgery.

"I wish you all good fortune. May this meeting be attended by every success and in the unending war against ill-health and disease may it light the way to new and splendid victories."

Presentation of jewels of office to the presidents of the American, Canadian, Australian, New Zealand and South African Orthopaedic Associations—After Her Majesty's moving speech—and with the deeply impressive ceremony, the speech which had been delivered with grace and charm in a beautifully modulated voice was indeed charged with emotion—Her Majesty received each president in turn and as he kneeled on the ceremonial kneeling-stool placed round his neck the presidential jewel.

The jewels of office were designed and created by Leslie Durbin, M.V.O., one of the leading goldsmiths in the world. The central theme, common to all the presidential insignia, is adapted from an illustration in Andry's *Orthopaedia*, the first publication on the prevention and correction of deformity, which was published in 1741 and translated to English in 1743, in which it was written:

> "If the leg is already crooked, you muft apply, as foon as poffible, a fmall Plate of Iron upon the hollow fide of the Leg, and faften it about the Leg with a Linnen Roller. This Roller muft be made tighter and tighter every day, till it compreffs fufficciently the Part that bunches out, and that this Compreffion may not hurt it, you muft put a large Comprefs under the Bandage, on that Part of the Leg. In a word, the fame Method muft be used in this Cafe, for recovering the Shape of the Leg, as is ufed for making ftreight the crooked Trunk of a young Tree."

Our distinguished craftsman has made it a plane tree, for it was beneath a plane tree that Hippocrates stood at Cos to teach his disciples. Moreover he has planned that the ropes binding the trunk to the stake should be held by cherubs—an indication of the spiritual basis of healing, the spirit that must be shared by physician and patient.

This design, indicating the science and art of orthopaedic surgery, is common to all the jewels—and yet there are still the characteristics of each nation. The clasp of the Canadian badge has the special device of the Canadian Orthopaedic Association—a maple leaf interwoven with the fleur-de-lis. The Australian jewel has a spray of wattle in the clasp and the Southern Cross below the panel. The New Zealand jewel has the kowhai flower above and an outrigger canoe below. The British presidential insignia includes the recently granted coat-of-arms. The American jewel, illustrated on the opposite page, has an American eagle in the clasp and their familiar inscription below.

The presidential jewels are reproduced in varying designs of yellow and white gold and though each is similar, each is different—implying that although the endeavour of orthopaedic surgeons throughout the world is the same, the traditions of each nation are different.

COMBINED EDITORIAL MEETING OF THE JOURNAL

Although it is one of the principles of agreement of joint American-British publication of the Journal that each year there shall be a combined editorial meeting at which one or more representatives of one Editorial Board shall attend a full meeting of the other, it is seldom possible for so representative a joint editorial meeting to be held as that which met in the Council Room of the Royal College of Surgeons of England in Lincoln's Inn Fields on the afternoon of Saturday, June 28. Not only was there strong representation of the American Board of Associate Editors as well as of the British Editorial Board, but for the first time we had the opportunity of welcoming to the American and British Editorial Boards nearly all the Corresponding Editors of European

and Latin-American countries. During the meeting each in turn presented messages of goodwill from his own country: Sten Friberg from Sweden, J. Mulder from the Netherlands, José Valls from Argentina, Godoy Moreira from Brazil, Oscar Scaglietti from Italy, A. Ródo from Portugal, K. E. Kallio from Finland and J. Mortens from Denmark. There were apologies for absence from Merle D'Aubigné of France (who attended later parts of the meeting,) W. Ehalt of Austria, A. Gruca of Poland, Jean Verbrugge of Belgium through ill-health, Juan Farill of Mexico, José Bado of Uruguay, and Alberto Inclan of Cuba.

In the course of a vigorous discussion on the duties of corresponding editorship it was agreed as essential that the Journal of Bone and Joint Surgery should publish summaries of the orthopaedic meetings of Societies in all countries as well as news of appointments, honours and distinctions to orthopaedic surgeons and events of general interest. It was emphasised that many readers of the Journal in the British Commonwealth and the United States turned first to the pages that dealt with the proceedings of Associations, Societies and Colleges in all countries, even before reading the scientific articles.

MEETING OF EDITORIAL BOARDS OF THE JOURNAL, WITH THE CORRESPONDING EDITORS, IN THE COUNCIL ROOM OF THE ROYAL COLLEGE OF SURGEONS OF ENGLAND

From left to right—E. Nicoll, Crawford Adams, Rufus Alldredge, Vernon Luck, James Dickson, Tom King, G. du Toit, Frank Dickson, Philip Wiles, Leo Mayer, Fremont Chandler, Sten Friberg, Lloyd Griffiths, J. Mulder, José Valls, Oscar Scaglietti, A. Ródo, Al. Shands, Winthrop Phelps, William Rogers, George Perkins, Watson-Jones, Miss Barnes, R. Raney, Joseph Freiberg, K. E. Kallio, Alex. Gillies, J. Mortens, Jim Scott, H. Wood. *Inset*—The same meeting later.

The meeting began with some formality but, as the inset to the illustration shows, it soon got down to hard work on a hot summer afternoon and coats were well off. Principles of agreement and financial problems, especially those arising from difficulties of exchange, were discussed as well as such matters as the publication of a five-yearly index, and the still more difficult problem of publishing world abstracts of orthopaedic surgery and of basic and allied sciences. The agreements were facilitated by the long preliminary discussions of the executives of the Editorial Boards which had met throughout Saturday morning. The most important agreement that was

ratified was the determination of British and American Editorial Boards to continue in their endeavour of joint publication. Immediately after the meeting, present and past members of the British Editorial Board were hosts to members of the American Board of Associate Editors and Corresponding Editors at a dinner in the River Room of the Savoy Hotel where the health of the Journal was toasted by Sir Harry Platt and responded to by Dr William Rogers, Editor-in-Chief.

LUNCHEON, RECEPTIONS AND LECTURES IN THE ROYAL COLLEGE OF SURGEONS OF ENGLAND

Luncheon on Monday, June 30—Immediately after the Inaugural Ceremony in the University, a luncheon was held in the Library of the Royal College of Surgeons, attended by the officers of the Orthopaedic Associations together with the President and Council of the College, Lord Woolton the Lord President of Council, Minister for Commonwealth Relations, Minister of Health and other distinguished visitors. Sir Cecil Wakeley, president of the College, in welcoming the Associations, referred to the Joint Committee for Postgraduate Orthopaedic Studies which had been working in London for two years with Mr Osmond-Clarke as its Executive Officer and with representatives of the Royal Colleges of England, Edinburgh and Glasgow, the Institute of Orthopaedics of the University of London, the Department of Orthopaedics of the University of Liverpool, and the various Regions of the Ministry of Health. Sir Reginald Watson-Jones in responding said how important it was that the first official luncheon of this meeting of orthopaedic surgeons should be held in the Royal College of Surgeons. Orthopaedic surgery was not a speciality: it was a part, an important part—some might think the most important part—of the whole wide field of surgery. Orthopaedics must always maintain its close alliance with general surgery.

Robert Jones Memorial Lecture—On Tuesday, July 1, the Robert Jones Memorial Lecture was delivered in the Royal College of Surgeons by Sir Max Page, C.B., K.B.E., on "The Effects of War on Surgical Practice." The largest lecture hall in the College was filled to overflowing.

Moynihan Lecture—Another statutory lecture of the College, one of the Moynihan Lectures, was delivered by Dr Leo Mayer on Thursday, July 3, on "The Development of Tendon Surgery." The lecture hall was again more than full.

Museums and historic displays—Before and after both these College Lectures the museums and some of the treasures of the College were inspected, including many specimens mounted by John Hunter—the Irish giant and the pigmy skeleton, the tooth transplanted to the cock's comb, and so on. There was a pathological display of orthopaedic interest, and a demonstration of such instruments as amputation knives used in the Battle of Waterloo, traction appliances many hundred years old, and spinal braces produced long before Thomas, Ridlon and Robert Jones—almost identical in design but with leather so beautifully embossed in decorative design and colour as to suggest that they were inducements to the patient.

MEETINGS OF SURGICAL CLUBS

Robert Jones Clubs of Britain and America—It is customary in England to hold a meeting of the Robert Jones Dining Club on the same evening that the Robert Jones Memorial Lecture is given in the Royal College of Surgeons, the lecturer being the guest of honour of the club. On this occasion there was a joint dinner of the two Robert Jones Clubs—the club of London and that of New York—with Sir Max Page as guest of honour. The dinner was arranged at the Travellers' Club on Wednesday, July 2, by V. H. Ellis who is the secretary in London.

A.B.C. Club—The club of the American-British-Canadian Travelling Fellows in Surgery held a dinner at the Savoy Hotel with Professor Robert I. Harris in the chair and afterwards discussed the steps that might be taken to maintain and perpetuate the ideals of the travelling fellowships.

Old Oswestrians—The opportunity was taken of this combined Orthopaedic Associations Meeting to found the Club of Old Oswestrians and the first dinner was held at the Savoy Hotel under the chairmanship of Sir Reginald Watson-Jones the president for the first year, attended by most of the surgeons who had trained at the Robert Jones and Agnes Hunt Orthopaedic Hospital, members of the consulting staff, Mr John C. Menzies secretary-superintendent, Major Needham chairman of the hospital, and Dr Salt vice-chairman. At 9 o'clock precisely a silent toast was drunk to the memory of Robert Jones and Agnes Hunt. The toast of the hospital was proposed by Sir Reginald Watson-Jones and there were responses from the chairman and the vice-chairman. In the course of the dinner it was agreed that: membership of the club shall include all who have been or are on the resident or consultant medical or surgical staff of the hospital; the purposes of the club shall be both academic and recreational, and especially to preserve the traditions of the hospital; a meeting shall be held once a year including a presentation on a surgical or scientific subject followed by discussion, with thereafter the annual dinner; the president shall be elected annually from among the members of the club; there shall be an executive of five, usually resident in Great

Britain, elected annually; the secretary shall be John C. Menzies, secretary-superintendent of the hospital. A special souvenir menu had been prepared which included photographs of all who had been on the resident staff, and it is proposed to bring this "rogues gallery" up to date year by year.

M.Ch.Orthians—Another dining club established during the combined meeting and holding its first Annual Dinner was that of the M.Ch.Orthians under the chairmanship of Professor B. L. McFarland. It was a lively and vigorous dinner attended by many orthopaedic graduates of Liverpool from overseas.

SOCIAL AND RECREATIONAL EVENTS

In preparing the social programme the Ladies Committee had been faced many months before by two conflicting views: one opinion was that visitors would prefer to arrange their own engagements and recreations, and that they should be left time to do so; the other was that at least a number of planned visits should be organised. A compromise was agreed and in addition to the Reception at Claridges on the eve of the meeting by the British president and his wife, the special Ballet performance at the Royal Opera House, Covent Garden, when more than a thousand of our members and guests enjoyed a superb performance of the "Sleeping Princess," the combined Annual Dinner at the Dorchester Hotel, and the Ball and July 4 Celebrations at Hurlingham Club, visits were arranged to Hatfield House, one of the historic homes of Great Britain built on the site of the Palace of the Bishops of Ely about 1490 and containing many treasures and traditional memories; to the Royal Docks, Wharves and Port of London, sailing down the Thames in "St Katherine" by the invitation of the Port of London Authority; and to the Houses of Parliament. A reception was kindly arranged at the Mansion House by the Lord Mayor and Lady Mayoress of London, who gave us the special privilege of inspecting the gold plate; and there was a day in the Stewards' Enclosure, Henley, on the occasion of the Royal Henley Regatta. The members of the Ladies Committee and the many secretaries who assisted them also planned personal and small group visits to Windsor, the Royal Academy, Glyndebourne, the Royal Festival Hall, Stratford-upon-Avon, the All-England Lawn Tennis Championships at Wimbledon, Canterbury Cathedral and so on.

The fact is that, when the time came, every single ticket had been taken up by 9.15 a.m. on the first Monday morning, registration only having supposed to begin at 9 a.m. although in fact all were hard at work by 8 a.m. Additional visits to the Houses of Parliament were hastily arranged; extra coaches were laid on for Hatfield House; a second boat on the River Thames was booked; additional basket lunches were ordered; and most of the organised visits were duplicated. It seemed that in the end, with the great enthusiasm and happiness that prevailed, nearly all were satisfied.

The success of the social programme was due no less to the scores of small dinner parties, cocktail receptions, visits to the Zoo, luncheons at Windsor, tea and sherry parties, buffet suppers at Highgate, after-dinner dances and receptions in Grosvenor Square, and all the small parties arranged on the spur of the moment bringing together families who had never met before, and establishing contacts and friendships which will be life-long, as well as reunions of those who had already met in the American, Australian or European continents.

ROBERT JONES GOLF CUP

One of the traditions of the British Orthopaedic Association is that a competition shall be held each year, on the occasion of the Spring Meeting, for the Robert Jones Golf Cup which was presented to the Association by the late Walter Rowley Bristow. This time it was arranged that the competition should be open not only to members of the British Orthopaedic Association but to those of all visiting Associations. The competition was at Sunningdale on a bright and sunny Tuesday afternoon. Although at one stage it seemed likely that J. V. Todd of Newcastle-upon-Tyne, secretary of the competition, might yet again win the cup, to the delight of many of us it was carried off by a Canadian—A. S. McConkey of Vancouver, British Columbia. The cup was presented to him at the Combined Annual Dinner by Mrs Florence Bristow herself. We learn that although of course he takes the replica home he will leave the cup in England.

COMBINED ANNUAL DINNER AND THE TOAST—THE ENGLISH LANGUAGE

The combined annual dinner of the Associations was at the Dorchester Hotel on Thursday, July 3, attended by 1,200 surgeons, wives and guests in full dress with decorations. Sir Harry Platt proposed the health of the guests, and the Minister of Health, the Rt. Hon. Iain Macleod, replied, saying that the link between so many participants of different colour, country, politics, race and religion was that they really cared that there are sick and broken people.

Toast of "Orthopaedic Surgery"—Dr Fremont Chandler, president of the American Orthopaedic association, in proposing the toast "Orthopaedic Surgery" referred to the practical gain in the

Top—Editorial Boards Dinner—Guy Pulvertaft, Crawford Adams, J. Mulder, Oscar Scaglietti, Norman Roberts, Charles Macmillan, Merle D'Aubigné, Relton McCarroll, Lloyd Griffiths, Vernon Luck, A. Ródo, Karl Nissen, José Valls, V. H. Ellis, W. Phelps, W. Blount, J. Seddon.

Upper middle—Part of the audience in ceremonial dress at the Inaugural Ceremony—the Dickson Wrights, Buxton former president, Wood, Malkin former president, Perkins former president, Osmond-Clarke; *To right*—Lord Moran examining the New Zealand presidential badge.

Lower middle—The Scaglettis; J. K. Elliott of Wellington, New Zealand, with the Lord Mayor of London; Professor Robert I. Harris.

Lower—A.B.C. Club Dinner—Fred Durbin, Bob Harris, Philip Newman, Ian Smillie, John Fairbank, James Wishart, James Patrick.

Her Majesty Queen Elizabeth the Queen Mother in her gown of the honorary degree of Doctor of Laws of the University of London.

Top right—Part of the Journal Dinner—Alex. Gillies, Frank Dickson, Bryan McFarland, Jackson Burrows, Watson-Jones, Esmond West, William Rogers, Harry Platt, Fremont Chandler, Leo Mayer, Osmond-Clarke, Sten Friberg, Norman Capener, Al. Shands, Roland Barnes, Guillaume du Toit.

Middle right—Esmond West, Tom King and Godoy Moreira; Sir Arthur Sims.

Bottom—Professor Walter Mercer, president of the Royal College of Surgeons of Edinburgh; The Lord Mayor of London, Sir Leslie Boyce, receiving his guests at the Mansion House.

Top—End of the reception-in-line by the American Orthopaedic Association—William Rogers, the James Speeds of Memphis, the Bob Johnsons of Baltimore, the Leslie Mitchells (Les. blotted out).
Middle—Sir Harry and Lady Platt and daughter; Bryan McFarland; Leslie Durbin, designer and craftsman of the presidential jewels.
Bottom—One of the Dinners—Harry Platt, Osmond-Clarke, Leo Mayer, Fremont Chandler, Sir Cecil Wakeley, president of the Royal College of Surgeons of England, George Perkins, Graham Huckell, Rufus Alldredge, Tom King, E. A. Nicoll, Joe Friberg, Jim Scott, Frank Dickson.
Lower right—The Leo Mayers, Guillaume du Toit; the Smith-Petes, the Fribergs of Sweden.

Top—Mont and Eleanor Chandler; James Dickson, Oscar Scaglietti and George Perkins.
Near top—Pamela May and her husband, Charles Gordon; William Rogers; Margot Fonteyne.
Middle—Old Oswestrians' Dinner—F. W. Davies, John Charnley, Herb. Coleman, Edgar Somerville, Fred Durbin, Fred Ward, G. K. Rose; the Merle D'Aubignés; Philip Wiles.
Bottom—Old Oswestrians—Tom Russell, H. Richards, Mr Thomas, vice-chairman of hospital, A. O. Parker, Major Needham, chairman of Robert Jones and Agnes Hunt Hospital, Watson-Jones, Dr Salt, chairman medical committee, John Menzies, secretary-superintendent and friend of so many overseas postgraduates, Miss May, F. T. Wheeldon, J. Mantle.
Lower right—Sir Russell Brain, president of the Royal College of Physicians, at the dinner.

Top—At Hurlingham Club on July 4—Noel Coward, Mary Martin and Joyce, daughter of Les. Mitchell, secretary of the American Orthopaedic Association. *Top right*—M.Ch.Orthians Dinner; some of those who were in Liverpool.

Middle—Esmond West, president of the Australian Orthopaedic Association and a great ambassador; Eddie and Louise Cave of Boston; José and Mrs Valls.

Lower—Sir Cecil Wakeley, P.R.C.S., Frank Dickson and H. James Seddon; the Sterling Bunnells.

Top—J. Duques, representing the Philippine Orthopaedic Association and College of Surgeons; Rufus Alldredge and Vernon Luck (the portrait is of Lord Nuffield); Arthur Le Mesurier; Alex. Gillies; K. E. Kallio and Tony Hendry; J. I. P. James, Edgar Somerville and John Charnley.

Middle—Sidney Higgs, past president B.O.A.; the Lady Mayoress of London cutting the cake in Mansion House (the cake had the new arms of the B.O.A. in sugar and ice); Walter Blount.

Below—Executive Meeting of the American Orthopaedic Association.

Top—Watson-Jones, Paul Magnuson, Lilian and Rex Diveley, Guillaume and Mrs du Toit; Arthur Steindler, Sam Irwin of Belfast, Walter Mercer, John Colquhoun of Australia.

Middle—Sail down the Thames to Port of London; damp but happy.

Lower—The Lady and Lord Webb-Johnson; Lady and Sir Thomas Fairbank; Jackson Burrows, Jock Edelestein, Godoy Moreira and Graham Huckell.

Top—Professor Bellot, Vice-Chancellor of the University of London; Germaine and Phil. Wilson; Miss Robertson, secretary of the Congress.

Middle—The president of the American Orthopaedic Association with the Lady Mayoress inspecting the gold plate at Mansion House.

Lower—Miss Margaret Simpson (secretary); Oswaldo Campos; Miss Jean Barnes (Editorial Secretary of the Journal); the Godoy Moreiras.

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advance of surgical knowledge that was made by such a joint conference of surgeons speaking a common tongue. Sir Reginald Watson-Jones responding, spoke of the steady development of orthopaedic surgery throughout many decades which had not been dependent on political reform or nationalisation but on the contrary might have been temporarily halted by it. But in the end he believed that recent developments in Britain would be beneficial because the garden was being tilled and tidied in its side tracks as well as in its main floral beds. After quoting from Rubert Brooke, he said: "We may not think much of our head gardeners but at least they have not pulled up the unofficial English rose and planted tulips which bloom as they are told." He believed that the conference had shown that the Commonwealth and the United States were held together by the pursuit of truth without political bias.

Toast of the English Language—The important toast of the evening, proposed so far as can be determined at an official occasion for the first time here or elsewhere, was the English Language, and few present will ever again hear oratory of the elegance, power and wit with which it was supported by the Marquess of Reading and the Rt. Hon. Lord Justice Birkett. All will agree that these two speeches were among the most brilliant they have ever heard.

The Marquess of Reading said: "To one who, like myself, has over the years consistently maltreated the English language in speech and writing this is a most gratifying, indeed a unique, occasion. For I find myself for the first time in a long and guilty career of tortured grammar and shattered syntax at last publicly atoning in some small measure for my crimes by proposing the health of the English Language. And no one is better qualified than Lord Justice Birkett to reply in its name, for it has always been shielded from violence and disrespect by his eloquent and accurate tongue.

" Bismarck said some seventy years ago that the most important thing in the modern world was that the people of America spoke English. Had he been alive to-day, he would presumably have said that the most important thing was that the people of England spoke American.

" Yet that verbal infiltration is, within limits, all to the good. No living language can afford to remain static; it must be an organic growth—even if the organ is a Wurlitzer—or perish, and even ' the well of English undefiled ' may in the end be the purer for an occasional tablet of American chlorine.

" We are to-day in many respects a poor country but the English language is still unrivalled in richness.

" Many years ago my father purchased a complete Oxford English Dictionary, which I now possess, and every time it catches my eye I am overwhelmed by a cosmic depression. For sometimes, when my head is averted from those monumental volumes, I flatter myself that I have a reasonably ample vocabulary. But one glance at the Oxford English Dictionary and I am less than the dust upon its covers, for I know that, wherever I may open a page at random, I shall find a series of words the sight, sound and significance of which are utterly unfamiliar to me. Its wealth is incomparable: it is a sort of linguistic Fort Knox, in which is stored the vast unseen and unused treasure of the English-speaking world.

" English is after all a synthesis of languages to which many others have lavishly contributed. At one moment it luxuriates in a polysyllabic Latinity. At another it beats out a rhythm in curt and pungent Saxon. At a third it is a balanced blend of both.

" Consider as an example Mr Winston Churchill, whose supremacy as a master of English to-day few would contest. Compare on the one hand the flamboyance of his youthful technique, which by a dexterous verbal alchemy could transmute a lie into a ' terminological inexactitude '—Latinity *in excelsis*. And on the other hand ponder the spartan economy of his later famous phrases:

' Never was so much owed by so many to so few.'

' I can offer you nothing but blood and sweat and toil and tears.'

' Give us the tools and we will get on with the job.'

And mark in those phrases the monosyllables. All but four words in those three sentences are monosyllabic and in the last every one, and almost every word in them is by derivation Saxon. And then note how they fall upon the ear with all the strength and sureness of hammer upon anvil. Perhaps only Lincoln amongst the great orators in the English language could have matched that stark severity and by the form no less than the content of his words branded them upon the memory of nations.

" But mere richness is not enough, and English possesses in addition remarkable qualities alike of precision and of subtlety, whilst in invective it has a range of rudery which frequently changes but happily never contracts.

" I admit that abominable words insinuate themselves at moments into the language but fortunately they seldom endure. To describe the painting of vehicles white for invisibility against

snow, or buff against sand, as ' arcticisation ' or ' desertisation ' was not a meritorious impulse; though the most infamously bastard war-baby was without doubt ' triphibious,' to denote combined operations by land, sea and air. It is hideous English and indefensible Greek and I hope that it has died in agony.

" More dangerous, because more persistent, seem to me the recurrent attempts to introduce what is commonly called basic but I prefer to call debased English. Surely, though ' English without Tears ' may be valuable to those from abroad trying to learn the language, English without effort is not essential for the people of this country.

" Shakespeare, so far as I am aware, had no very wide education. Yet he knew quite a lot of words and used them with considerable address.

" Here is a language rich, beautiful, supple, resonant and strong. Let us not condemn it to pernicious anaemia but rather drink to its abiding and increasing vigour and health."

Lord Justice Birkett, responding, said that English with its flexibility and its words from every possible language could deal with every situation. He agreed that it should not be afraid of

Combined Annual Dinner of the Orthopaedic Associations of the English-speaking World at which the important toast was " The English Language," proposed by Lord Reading and responded to by the Rt. Hon. Lord Justice Birkett.

importations and he acknowledged our debt to America for such expressive inventions as " sobstuff," " sky-pilot," " highbrow," " tenderfoot " and " lounge-lizard." But with the vitality of living speech we must seek also lucidity and grace—the one to make our thoughts plain, and the other to make them memorable. Illustrating from Shakespeare what C. E. Montague called the " glamorous prestige of words in high company," he said that although it was our duty to welcome every importation that might live by its vitality, we had also a responsibility as trustees. The English tongue was one of the bonds between the nations that used it, and in such bonds lay the chief hope of the world.

We had hoped to publish the full text of Lord Justice Birkett's speech and, in response to all who have asked for it, we can only quote his letter: " The spoken word depends on all sorts of elements to create the impression of the moment, as Hazlitt said in a memorable essay, and I think it is a mistake to try and recreate in the written word what was essentially a mood and the expression of it." Thus, though the text cannot be published, we retain the memory of a brilliant feat of oratory.

JULY 4 CELEBRATIONS

The British National Anthem had been played by the orchestra of the Grenadier Guards at the Inaugural Ceremony; " O Canada " was played on the morning of Tuesday, July 1, Canada Day, before the scientific programme began; and on Friday, July 4, the work of the day was preceded by the American National Anthem. In the late afternoon the American Orthopaedic Association held a reception at Claridges for all attending the meeting together with their wives and guests. It was a happy occasion, the guests being received in accordance with American tradition by present and past officers of their Association standing " in line."

In the evening a July 4 celebration was held at Hurlingham Club with an impressive firework display, music, refreshment, dancing which went on until the morning but for many stopped too soon, and a cabaret generously offered by the two world leaders in their art—the leaders of America and Britain—Miss Mary Martin and Mr Noel Coward.

Our distinguished visitors were received by Lady Watson-Jones who in a short speech paid tribute to the ladies who had worked with her in Britain, and by Joyce Mitchell daughter of the secretary of the American Orthopaedic Association who presented a bouquet to Miss Mary Martin. Our debt to them is the greater since to entertain us one of them had to leave her theatre audience too soon and the other had to reach his midnight audience too late. We are grateful to Miss Martin for her vivacity, and to Mr Noel Coward—composer, producer, actor, singer, writer. It was a happy evening and the long line of taxis ready to take our members back to London waited until the early hours of the morning.

THE EDINBURGH MEETING

The coach party arriving from Oswestry, Liverpool and the Lake District were joined on Friday night, July 11, by others who had travelled independently, including the presidents of the Canadian and Australian Orthopaedic Associations (the presidents of the American and New Zealand Orthopaedic Associations having already been and gone) so that nearly fifty visitors were received at a cocktail reception at the Caledonian Hotel. On Saturday morning Professor Mercer gave an electric display of his operative skill—a Judet arthroplasty was finished within thirty minutes, and before full breath had been taken a knee joint had been arthrodesed. There was a demonstration of controlled hypotension during anaesthesia by hexamethonium bromide and of interesting clinical cases including: an unusual tumour of the heel, osteopathy of the lower end of the fibula, fracture-dislocation of the spine, subtalar fusion with demonstration of specimens, Syme's amputation, osteogenesis imperfecta, post irradiation fracture of the acetabulum, and replacement of upper femur resected for giant-celled tumour by prosthesis.

Visits were made to the Westerlea Special School for the treatment and education of spastics and Mr Anderson did a tibial lengthening operation at the Princess Margaret Rose Hospital. At this hospital Mr R. I. Stirling welcomed the guests to luncheon, and clinical presentations included Mr Baker's discussion on changes in the capital epiphysis of the femur in congenital dislocation of the hip, and Mr Pollock's coloured film of an operation for selective lengthening of the gastrocnemius tendon.

Meanwhile the ladies had been taken on shopping and sight-seeing expeditions by Mrs Mercer and the ladies of her committee. Luncheons were arranged in their homes and visits were made to East Lothian, North Berwick and the shores of the Firth of Forth. The dinner in the Hall of the Royal College of Surgeons of Edinburgh was under the presidency of Professor Walter Mercer and his wife. The toast of the Edinburgh School was proposed by Mr Esmond West, president of the Australian Orthopaedic Association and in his response, Mr R. I. Stirling referred to the contribution made to surgery by Syme, Goodsir, Annandale and Bowden. The last toast of the evening made history; Mr John Bruce in his inimitable style proposed " The Lassies "—it was the great success of the week-end.

SCIENTIFIC PROGRAMME

Traumatic dislocation of the hip joint—*Mr E. A. Nicoll* (Mansfield, England) had reviewed 144 cases of traumatic dislocation of the hip joint treated by a number of surgeons forming a clinical research group of the British Orthopaedic Association, and followed up for from two to ten years. The study so far had been confined to the problem of avascular necrosis of the femoral head, the incidence of which was 10 per cent. Mr Nicoll emphasised the need to distinguish between avascular necrosis and " traumatic " osteoarthritis: in avascular necrosis radiographic changes always developed within two years of injury, whereas in traumatic arthritis they occurred more slowly and might not appear for four years or more. In avascular necrosis radiographic changes

preceded symptoms. No statistics were available from which to determine the incidence of avascular necrosis in children; theoretically it might be greater than in adults because the epiphysial plate was a barrier to the flow of blood from metaphysis to epiphysis, whereas in adults there was a good collateral circulation between femoral neck and head. Mr Nicoll's figures suggested that significant factors in the causation of avascular necrosis were: 1) delayed reduction or repeated attempts at reduction, and 2) early weight bearing. Discussing treatment, he said that it was impracticable to rely upon revascularisation by "creeping substitution" because it was too slow to permit survival of the articular cartilage (except perhaps in children). He advised avoidance of weight bearing for five or six weeks; thereafter radiographs should be taken every three months to detect the possible development of avascular necrosis. If it occurred treatment was as for osteoarthritis: in many cases conservative measures sufficed (as in nine of the fifteen cases of aseptic necrosis in this series).

Dr Marcus Stewart (Memphis, Tennessee), presenting a paper prepared with Dr J. S. Speed (Memphis, Tennessee), reviewed 193 cases of traumatic dislocation of the hip joint of which 128 had been followed up, fifty for more than ten years. Dislocations were classified into anterior, posterior, and central. Age, method of injury, time before weight bearing, and myositis had no bearing on the result. Important factors determining the results were: 1) interval before reduction; 2) severity of injury; 3) type and grade of dislocation; 4) treatment; 5) osteoarthritis; 6) sciatic nerve injury. Each type of dislocation was graded as follows: 1) dislocation without fracture; 2) dislocation with fracture of acetabulum but joint stable after reduction; 3) dislocation with fracture of acetabulum, joint unstable after reduction; 4) dislocation associated with fracture of the head or neck of the femur. In each type of dislocation the most important factor determining the result was the interval before reduction. Most cases with good or excellent results were those in which immediate reduction had been carried out; whereas when reduction had been deferred for twelve hours or more the result was poor. Discussing the question of avascular necrosis Dr Stewart suggested that deprivation of blood supply was not the sole cause of the necrosis; he believed that a contributory factor was death of bone from the effects of direct trauma which might produce intracellular changes in the bone cells. In their series the incidence of avascular necrosis was 15·5 per cent in cases reduced without operation and 40 per cent after operative reduction. The incidence of osteoarthritis was 48·8 per cent after conservative treatment and 71·4 per cent after operative treatment; and the incidence of sciatic nerve lesions, some of them transitory, was 13·3 per cent. He emphasised three points in treatment: 1) traumatic dislocation of the hip should be regarded as a surgical emergency and reduction undertaken at the earliest possible moment; 2) immobilisation was necessary only if the hip was unstable; otherwise active movements were encouraged; 3) prolonged avoidance of weight bearing was unnecessary.

Discussion—Dr Paul B. Magnuson (Washington, D.C.) said that sooner or later traumatic arthritis became evident in almost every joint that had been seriously injured. He cited the example of slipped femoral epiphysis, in which degenerative changes usually developed, often many years after the initial lesion. He recalled that in the treatment of avascular necrosis of the femoral head he had suggested hollowing out the head of the femur and placing the hollowed head upon the rawed shaft or neck of the femur. The hollowed head served as a thin bone graft and was soon revascularised by "creeping substitution." Patients so treated had been able to bear weight on the limb within six to eight weeks. Weight bearing stimulated the restoration of normal bone structure. *Mr James Patrick* (Glasgow, Scotland) agreed with Mr Nicoll that a clear distinction between avascular necrosis and osteoarthritis was not always made. He recalled experiments that he had undertaken with cancellous bone removed from the femoral head: the block of bone had been kept near body temperature for some months and was then subjected to intermittent pressure by tapping with a weight; after about twenty taps the bone collapsed and radiographically showed areas of dense compact bone similar to those seen in cases of avascular necrosis. He suggested that in avascular necrosis there was autolysis of the bone structure which, after some months, collapsed from intermittent pressure of weight bearing. "Compaction" of cancellous bone was more reliable as a sign of avascular necrosis than relative density of the head alone. In view of the seemingly high incidence of avascular necrosis after dislocation in children he had tried drilling the epiphysial plate and inserting a fibular graft. Three months later the aseptic area had collapsed but appeared of normal density. He interpreted this as indicating that the fragment had revascularised as a result of drilling and grafting, but that this had only accelerated the process which in time would inevitably have occurred. He believed, with Dr Speed and Dr Stewart, that once avascular necrosis was evident nothing could stop its consequences. He had contemplated drilling the epiphysial plate prophylactically after dislocation in children. *Dr J. M. Edelstein* (Johannesburg, South Africa) did not consider that avoidance of weight bearing could do more

than prevent collapse of the femoral head. He suggested replacement of the dead head by a prosthesis. *Mr K. H. Pridie* (Bristol, England) believed, from studies of sections from femoral heads excised in cases of osteoarthritis, that avascular necrosis and traumatic arthritis were one and the same thing, the variation being one of degree. Massive avascular necrosis was easily recognised; but smaller areas of necrosis beneath the articular cartilage inevitably caused death of the overlying cartilage with consequent osteoarthritis. *Mr Nicoll*, closing, said that it was reasonable to drill the epiphysial plate to break down the barrier to the flow of blood, but if a hole was drilled it should not be filled with a graft. He hesitated to replace the femoral head by a prosthesis in relatively young patients because the long-term results after prosthetic replacement were not known. *Dr M. Stewart*, closing, could not agree with Mr Pridie that avascular necrosis and traumatic arthritis were the same. He had employed drilling and grafting to encourage " creeping substitution " for ununited fractures of the femoral neck, but not for necrosis after dislocation.

Orthopaedic management of the arthritic hip—*Dr Frank Stinchfield* (New York) had studied groups of patients with osteoarthritis of the hip treated by various methods. He did not propose to advocate any one method, but rather to assess the merits and disadvantages of each method. *Arthrodesis*—There were 108 cases of arthrodesis for osteoarthritis followed up for from two to fifteen years (average seven years). When bone fusion was secured the results were good. But, despite a technique which included intra-articular denudation, internal fixation, and a bone graft from ilium to trochanter, pseudarthrosis developed in 22 per cent of cases (in half of these fusion was secured at the second attempt). A third of the patients had low back pain after fusion (in thirteen pain was present before operation), and 9 per cent had a painful knee. Arthrodesis was suitable mainly for relatively young patients with unilateral disease. It was especially suitable for heavy manual labourers who demanded a stable hip, and for patients who were not prepared to work hard on post-operative exercises after arthroplasty. He believed that it was suitable also for old infective arthritis. It was inadvisable in very old patients, in bilateral disease, in sedentary workers, in patients with low back pain, or in those who would not tolerate prolonged immobilisation. The high rate of pseudarthrosis was disturbing. *Mould arthroplasty*—Forty-four cases had been studied. Patients valued relief of pain more than preservation of movement. He had found that movement tended to decrease for several years after operation. Mould arthroplasty was mainly useful in patients of middle age with bilateral disease, and in sedentary workers. Coxa valga was an advantage because it favoured a mechanically sound joint. An advantage of mould arthroplasty was that it left the field open for further reconstructive surgery should this be necessary. Mould arthroplasty was unsuitable for very old patients, for heavy manual labourers, and for uncooperative patients. It was unsatisfactory mechanically when the femoral head had disintegrated and in coxa vara. *Judet-type prosthetic replacement*—Thirty-one operations had been undertaken but the follow-up was too short to be of real value. So far as he could judge the following factors favoured the choice of the operation: 1) very old patients; 2) bilateral involvement; 3) sedentary workers who required movement; 4) coxa vara; 5) avascular necrosis; 6) normal acetabulum; 7) absence of femoral head. A long femoral neck was desirable to give the prosthesis a firm hold on the femur, and to prevent approximation of trochanter to ilium. Judet type replacement was probably inadvisable in young patients, in manual labourers who wanted stability, when the femoral neck was short or osteoporotic, in coxa valga, or when the acetabulum was shallow.

Discussion—Dr O. Au Franc (Boston, Massachusetts) thought that the failure rate of 22 per cent in arthrodesis was strikingly high. It meant that the results were very uncertain. Moreover, arthrodesis tended to aggravate the symptoms in the other hip if minimal arthritic changes were present, whereas after arthroplasty minimal symptoms in the opposite hip tended to improve. Other objections to arthrodesis were the prevalence of post-operative back pain and, especially in young patients, the tendency to gradual adduction after sound fusion. He claimed that even heavy manual labourers could return to work after mould arthroplasty. He believed that most patients, handled correctly, would co-operate in post-operative treatment to restore power and movement after arthroplasty. He considered that arthroplasty was more likely to be successful after old infective arthritis than was arthrodesis. He submitted that Dr Stinchfield's indications for arthrodesis were, in fact, indications for arthroplasty. *Mr W. A. Law* (London, England) emphasised that there was no universal operation for osteoarthritis of the hip. He was impressed by the high failure rate of 22 per cent after arthrodesis, and by the high incidence of pain in the knee and back. In his own series of mould arthroplasties relief of pain had usually been satisfactory, and the average movement retained was half to two-thirds of the normal range. He had not found that movement decreased in later years. His experience of the Judet operation was too short to be of value. He had the impression, however, that although the reconstructed joint was mobile at first it tended to stiffen later. The significance of loosening of the prosthesis had yet to be determined.

Experiences in the evolution of a new operation for osteoarthritis of the hip joint—*Mr John Charnley* (Manchester, England) described a technique of arthrodesis of the hip in which a central dislocation was deliberately produced, the floor of the acetabulum being drilled by special reamers and the femoral head and neck being shaped to fit snugly into the hole. Abutment of the trochanters against the margins of the acetabulum gave remarkable stability. When he began to develop this technique four years ago he had been sceptical of the possibility of achieving bony fusion of the hip with certainty. His aim had been to ensure a sound fibrous ankylosis and, owing to the large surfaces of contact, ankylosis was, in fact, sound and completely painless. More recently, by the use of compression through a spring, he had been successful in obtaining bony fusion in most cases. A short plaster spica was applied after operation but it had been found unnecessary to immobilise the knee. Mr Charnley showed convincing radiographs and illustrated some first-class results by a film.

Discussion—Dr J. R. Naden (Vancouver, British Columbia) said that in the treatment of osteoarthritis of the hip arthrodesis was often avoided because of the difficulty of ensuring sound fusion. He was able to say, from personal experience of having a soundly fused hip in good position, that the patient was able to adapt himself easily to the slight inconvenience that it entailed. He was impressed by Mr Charnley's method and since reading his paper he had performed the operation on one of his patients. In an attempt to avoid the necessity for plaster fixation he had employed internal fixation by a long nail driven down from the ilium into the femur.

Advantages of adduction deformity and internal fixation in ischio-femoral arthrodesis for tuberculosis of the hip joint in the adult—*Mr Thomas King* (Melbourne, Australia) drew attention to the advantages of allowing adduction to occur in a tuberculous hip during the active stage of the disease. It simplified ischio-femoral fusion by approximating the femur to the pelvis and allowing a short graft to be used. After displacement osteotomy at the time of arthrodesis, the femoral shaft was stabilised by impingement against the wall of the pelvis. He had encouraged adduction by placing the groin strap of the Jones frame on the affected side instead of on the sound side as in the usual method of fixation. After insertion of a fibular ischio-femoral graft, the osteotomy was secured by a nail-plate, thus obviating the need for immobilisation in plaster. His practice was to do the operation through a posterior incision, with the patient prone or semi-prone; in this way the course of the graft could be seen and its implantation into the ischium assured.

Discussion—Dr Halford Hallock (New York) said that adduction was unquestionably an advantage when ischio-femoral arthrodesis was to be undertaken. He had not used internal fixation in fusing tuberculous hips because of the fear of spreading the disease into the pelvis. He advocated fusion of tuberculous hips at an early stage of the disease and in most cases the operation was undertaken as soon as the diagnosis was established. *Mr H. Osmond-Clarke* (London, England) reported the comments of *Mr H. A. Brittain* (Norwich, England) who was absent through illness, on Mr King's method. Mr Brittain preferred the lateral approach; he disliked passing a metal nail through the tuberculous area; he preferred to use tibia for the graft rather than fibula; he disliked fixation of the osteotomy because he believed that initial mobility at the osteotomy favoured sound fusion at the hip; and he disliked doing ischio-femoral arthrodesis in severely adducted hips because the adduction was usually associated with flexion, which entailed risk of damage to the sciatic nerve. *Mr G. Parker* (Middlesbrough, England) had also treated active tuberculous hip joints by encouraging adduction on the frame. He did not like the posterior approach for ischio-femoral arthrodesis. He did not fear injury to the sciatic nerve because he drove the chisel and graft in the plane of the nerve rather than at a right angle to it. *Mr M. C. Wilkinson* (Black Notley, England) did not believe that the fused hip was the result to be sought for in tuberculosis of the hip joint. He had had considerable success in retaining a symptom-free movable hip as a result of treatment by antibiotics and synovectomy. *Dr D. Bosworth* (New York) emphasised that two classes of cases should be distinguished: those in which the head and neck of the femur had been lost, and those in which they were still present. The treatment was different in the two types.

Osteoid osteoma—*Mr John Golding* (London, England) recalled the clinical and radiological features of osteoid osteoma, described by Jaffe in 1935 (Archives of Surgery, **31,** 709). He had studied thirty-four cases, kindly contributed by his colleagues, of which twenty-six had been proved histologically. The essential features were a small focus of transradiancy surrounded by a zone of sclerosis. Severe and continuous pain was the main symptom. Bones of the lower limb, especially the tibia, were most commonly affected. Discussing the pathology, he emphasised that the lesion was highly vascular. Clinical diagnosis was difficult and in some cases the patient had been considered neurotic. Pain might be felt at a distance from the lesion, especially in lesions of the vertebrae, the greater trochanter, and the posterior aspect of the upper part of the tibia.

Even radiographically diagnosis might be difficult; a careful technique was necessary to show the small focus of transradiancy. He believed with Jaffe that the lesion was a benign neoplasm. The highly vascular nature of the tumour possibly accounted for features atypical of other benign neoplasms, such as the pain, the extent of the surrounding sclerosis, and the self-limiting course of the disease. Since spontaneous cure was possible excision of the lesion was not always necessary; radiotherapy might be tried in the hope of reducing the vascularity of the lesion.

Discussion—Dr H. H. Young (Rochester, Minnesota) agreed that diagnosis was often difficult. He recalled four cases in which an erroneous diagnosis of prolpased intervertebral disc had been made; sciatic pain had been the main clinical feature. In three, osteoid osteomata were found in the shaft of the femur; in the fourth, multiple osteomata were present in the greater and lesser trochanters of the femur. Ten years ago he had doubted the entity of osteoid osteoma, but a year ago he had published a paper refuting his previous ideas since he was now convinced of the entity of the condition. He was not sure, however, that it was neoplastic in origin. He favoured excision of the lesion because the natural course of the disease was long and the pain severe. *Dr John R. Moore* (Philadelphia, Pennsylvania) thought that osteoid osteoma could be classified according to its anatomical site. He recognised four types: 1) cortical, 2) cancellous, 3) subperiosteal, 4) with or without joint manifestations simulating arthritis.

Major determinants of normal gait—*Professor J. B. Saunders* (San Francisco, California) had made extensive studies of the complex phenomena of normal gait. He said that the body contrived to progress with the least possible expenditure of energy. Since nature had not discovered the wheel, it employed the next most economical mode of progression in which the centre of gravity moved along a sinusoidal pathway of low amplitude. The pathway was sinusoidal in both the vertical and the lateral plane. Illustrating his discussion by pictures of models, he showed that a simple "compass" gait would be expensive of energy. The body, to economise in energy, made use of six major determinants, by which the amplitude of the sinusoidal curves was minimised. The following determinants minimised vertical amplitude of the pathway: 1) pelvic rotation; 2) pelvic tilt; 3) knee flexion; 4) and 5) ankle and foot movements interacting with knee. The effect of these determinants was that functionally the legs were lengthened two and a half times. The sixth determinant, the femoro-tibial angle, minimised the lateral amplitude of the pathway. In normal gait the centre of gravity traversed a sinusoidal path which was deflected about two inches vertically and two inches laterally.

Evaluation of pathological gait—*Dr Verne T. Inman* (San Francisco, California) continued the general thesis presented in the previous paper. His studies with *Professor J. Saunders* had shown that a sinusoidal pathway of low amplitude was the most economical method of progression. Energy was used in two ways: 1) elevation and depression of the centre of gravity, and 2) oscillation of the legs. Energy used in the *elevation and depression of the centre of gravity* had been measured and studied by "force plate" oscillograms in normal and pathological gaits. If one or more of the six determinants enumerated in the previous paper was lost, the body attempted to compensate by exaggeration of the remaining determinants. If only one determinant was lost compensation was such that there was no marked change in the resulting path of the centre of gravity. Examples of loss of determinants that were readily compensated were fusion of the ankle joint and fusion of the knee. Similar compensation occurred in a woman walking in high-heeled shoes. In the case of fusion of the hip two determinants were lost and interference with the pattern of curve was greater. Whenever the normal sinusoidal pathway was interfered with a corresponding increase of energy was required for progression of the body. Thus studies of the gait of patients with above-knee amputation showed that 27 per cent more energy was required than in persons with normal gait. *Oscillation of the legs* expended about half the total energy used in walking.

Treatment of traumatic paraplegia—*Mr F. Holdsworth* (Sheffield, England) reviewed the treatment of paraplegia from thoraco-lumbar vertebral injuries, basing his remarks on his experience of forty-seven cases treated directly from the time of the injury, and twenty-one cases received after initial treatment elsewhere. He recalled that the most lethal complications were pressure sores and urinary infections; other important complications were angulation of the spine, myositis ossificans, and stiff joints. In the care of the bladder he used an in-dwelling catheter with free drainage. He claimed that pressure sores could always be prevented by nursing the patient carefully on pillows, and turning him every two hours; external fixation by plaster must be avoided. There had been no case of pressure sore in his forty-seven cases treated from the time of injury. He recalled that the commonest site of vertebral injuries causing paraplegia was in the thoraco-lumbar region, especially T.12 to L.1. The neurological lesion produced by injury

at this level was a mixed one consisting partly of cord injury and partly of damage to the nerve roots. At this level it was possible to determine quite early the extent of cord and root damage respectively, and whether or not the nerve damage was complete. Since there was a possibility of recovery after damage to the nerve roots, the vertebral displacement should be corrected immediately. The extent of the immediate treatment depended upon the stability or otherwise of the spine. This was not always easy to determine, because radiographs did not show the maximal displacement that had occurred or the extent of potential redisplacement. Crush fractures with intact posterior ligaments were usually stable whereas fracture-dislocations produced by rotational force, with fracture of one or both articular facets, were unstable. If the spine was unstable he advised internal fixation by metal plates bolted to the spinous processes so that external fixation could be avoided and correct nursing continued. He supported his conclusions as to treatment by comparing the results in the forty-seven cases treated from the time of injury with those in twenty-one cases treated by other methods. In his own series there had been no bedsores and no serious complications, and the stay in hospital averaged ten months. In the other cases complications were frequent and the average stay in hospital was two years. *Mr E. A. Nicoll* (Mansfield, England) said that Mr Holdsworth's paper was the most fundamental contribution to the problem for many years. He agreed with Mr Holdsworth's methods, which he himself had practised for three years. Plaster fixation was certainly dangerous. Internal fixation, to be successful, must afford sufficient rigidity to permit frequent turning. *Colonel A. W. Spittler* (Washington, D.C.) agreed with Mr Holdsworth's thesis. In military practice it was not always possible to treat the patient from the beginning and in many patients ulceration or bladder symptoms were already present on admission to the paraplegia centre. He had placed reliance upon a turning frame to relieve pressure. He did not use metallic internal fixation because he considered that it gave insufficient stability, which was ensured only by bone grafting. *Dr L. Guttmann* (Stoke Mandeville, England) had had experience of 800 cases of paraplegia, 600 of which were traumatic. Rehabilitation should begin immediately. He agreed that plaster fixation was dangerous. For the bladder he preferred an in-dwelling catheter with tidal drainage to suprapubic cystostomy. He considered that with correct treatment most paraplegic patients should be able to return to useful activity within seven to twelve months of the injury. *Dr Philip Wilson* (New York) described his experiences with internal fixation of the spine by metal plates. Fixation was unlikely to last more than four weeks because of compression necrosis of the spinous processes. If more permanent fixation was needed bone grafts should be used. *Sir Reginald Watson-Jones* (London, England) said that though he distrusted metallic internal fixation without external support, he believed that it was right to use it in traumatic paraplegia, for all that was required was temporary fixation for four to five weeks. After that there was sufficient stability to prevent serious displacement. The success of Holdsworth's treatment depended not only on the operation of internal fixation but also on superb first-aid treatment, brilliantly successful management of the bladder, and magnificent rehabilitation thereafter. He had made a most important contribution.

Man with three legs—*Mr I. S. Smillie* (Dundee, Scotland) related the extraordinary background and circumstances of the discovery of a middle-aged recluse with a rare congenital anomaly taking the form of an additional hemipelvis and complete lower limb, together with additional external genitalia. The appendage was illustrated and reference made to comparable examples from the literature. The dramatic account of this story was strangely reminiscent of Treves's "Elephant Man."

Management of fracture-dislocation of the cervical spine—*Dr William Rogers* (Boston, Massachusetts) described his experiences with seventy-seven cases of fracture and fracture-dislocation of the cervical spine treated at the Massachusetts General Hospital between 1940 and 1951 inclusive. Fifteen patients had died, all except three from paraplegia. The most frequent cause of paraplegia was anterior fracture-dislocation, but he had not been able to correlate the extent of the dislocation with the extent of the cord injury. Cervical injuries were most dangerous in patients with degenerative arthritis of the cervical spine; in such cases the cord was in grave jeopardy even if there was no immediate paraplegia. Dr Rogers discussed the mechanism by which paraplegia might be produced in cases with normal radiographic findings. He believed that massive displacement of disc material, or infolding of the ligamentum flavum, was sometimes responsible, but that the older concept of hyperflexion dislocation, with spontaneous reduction, was correct in some cases. He emphasised the necessity for careful initial treatment. Ten per cent of patients in his series had sustained cord injury after the accident, either during transport to hospital or after admission. Laryngeal intubation was especially dangerous, and only reliable traction devices, such as the Barton tongs, should be employed. *Mr V. H. Ellis* (London, England) said that although

there was little new in Dr Rogers's paper it nevertheless taught us the lesson that patients with fracture of the cervical spine were in grave danger, even though they had no immediate paralysis. There was continued danger until stability was restored. The best way to restore stability was by skull traction which should therefore be applied as soon as possible. He further emphasised that though the spine might be stable while skull traction was maintained, redisplacement might occur when the traction was removed. He therefore advocated wire fixation and fusion of spinous processes to ensure permanent stability. *Dr T. C. Thompson* (New York) described a little-known method of skull traction by means of modified fish-hooks inserted below the zygomatic process of the skull. He had found the method simple, effective and reliable. He had found that upper cervical fracture-dislocations were unstable, and for these he advised internal fixation. *Dr Philip Lewin* (Chicago, Illinois) made a plea for efficient first-aid treatment by improvising immediate traction to minimise the risk of serious displacement during transport to hospital.

Adreno-cortical response in orthopaedic conditions and operative procedures—*Dr Philip Wilson* (New York), presenting a paper prepared in conjunction with *Dr James Nicholas* (New York), said that too little attention had been paid by orthopaedic surgeons to the response of the body to operative procedures. He recalled the mechanism of adrenal stimulation in the alarm reaction and its effects. He had studied the reaction in 175 orthopaedic patients by eosinophil counts, which were reduced through an adrenal mechanism under the influence of stress. Before operation, patients prepared for elective operations, such as reconstructive procedures for poliomyelitis, showed no depression of eosinophil level, whereas patients with cerebral palsy, low back pain, bone tumours, most infections, injury and fractures, had a lowered eosinophil count. After operation there was always an immediate eosinopenia with return to pre-operative level usually within forty-eight hours. The more severe the operation the slower was the return to pre-operative level. When eosinopenia persisted for more than five days, the patient usually remained ill and was liable to serious complications. After operations in which large masses of metal or plastic appliances had been inserted, eosinopenia tended to persist even though the patient appeared well. *Professor J. Trueta* (Oxford, England) agreed with Dr Wilson's conclusions. This study was very important. One difficulty was that eosinopenia from hyperadrenalism was inconstant. It was, nevertheless, sufficiently reliable to make Dr Wilson's study very valuable. *Dr R. B. Raney* (Durham, North Carolina) said that Dr Wilson's paper was a fundamental contribution to orthopaedic thought. This problem was a common meeting-ground of all branches of medicine. He was uncertain that eosinopenia necessarily indicated adrenal overaction. The chain of reactions might be broken at other points.

Case of neurological arthropathy—*Dr Gordon Petrie* (Montreal, Canada) described a girl who had complete indifference to the usual pain-producing stimuli. In other respects she was normal and there was no evidence of organic neurological disease. Biopsy had shown that normal nerve endings were present and the disturbance was presumably central in origin. In the course of observation the patient developed neurological arthropathies of ankle, knee, hip and spine, ultimately developing an upper motor neurone lesion from mechanical obstruction of the spinal canal which was relieved by decompression. Dr Petrie discussed the possible cause of the joint changes in neurological arthropathy. He believed that multiple minor injuries to the painless joint were the essential feature. In the treatment of the affected joints arthrodesis was practicable but threw additional stress upon the adjacent joints, which might in turn develop arthropathy. *Dr Edward Compere* (Chicago, Illinois) said that recent publications had thrown doubt upon the part played by loss of pain in producing neurological arthropathy, but the observations made in Dr Petrie's case supported the theory that loss of pain sensation alone had led to the joint changes. He agreed that it was practicable to fuse a Charcot joint provided a massive graft was employed. *Mr G. K. Rose* (Wellington, Shropshire) described a similar patient at the Robert Jones and Agnes Hunt Orthopaedic Hospital, Oswestry, who had complete absence of pain sensation and could be lifted up by his hair without discomfort. This patient bit pieces from his fingers leaving whole-thickness skin loss. He developed osteochondritis of the ankle joint, but in this case the joint had shown considerable capacity for healing and the lesion was resolving.

Congenital phalangeal fusion through many generations—*Mr Ian Paterson* (Edinburgh, Scotland) described a case of congenital fusion of the proximal interphalangeal joints of all the fingers. The anomaly was present in the patient's father, uncle and cousins and it had been present in his grandfather. The family claimed descent from the Shrewsbury family. Research had shown that members of the Shrewsbury family since John Talbot, who was born about 1390, had the anomaly described. In the nineteenth century the finger bones of John Talbot had been exhumed; they showed an anomaly similar to that present in the generation of Shrewsburys living at that time.

Structural changes in the lumbo-sacral region and their significance as causes of low back pain and sciatica—*Dr Ian MacNab* (Toronto, Canada), presenting a paper prepared with *Dr R. I. Harris* (Toronto, Canada), reviewed anatomical studies undertaken on 123 subjects post-mortem. He recalled the changes found in intervertebral discs that had undergone degeneration. Degeneration was a natural process of ageing but he preferred to reserve the term for the process occurring prematurely or in exaggerated degree. Disc degeneration led to secondary changes in other components of the spine. The most important were osteoarthritic changes in the posterior intervertebral joints, which followed the typical pattern of osteoarthritis elsewhere. In conjunction with disc degeneration they led to instability of the spine, with excessive antero-posterior movements of one vertebra upon another. It seemed reasonable that such excessive mobility could predispose to strains of surrounding soft tissues, ligaments, etc., with consequent pain. Dr MacNab had also shown, by dissections, that degenerative changes could lead to encroachment upon intervertebral foramina with direct pressure on nerve roots. He demonstrated the early radiographic signs of degenerative changes, emphasising the importance of obtaining flexion-extension films to show possible antero-posterior displacement and oblique films to show the condition of the posterior joints. He stated that the spine functioned as a whole and that changes in one part led to secondary changes in another.

Spondylolisthesis—*Mr E. F. West* (Adelaide, Australia) had studied the problem of spondylolisthesis with particular reference to the etiology, pathology and treatment. He recalled that in the typical form of spondylolisthesis the underlying causative factor was a defect of the bony lamina, usually bilateral. The causes of the defect were still unknown. It had been variously ascribed to non-fusion of double ossific centres, to birth fractures, and to stress fractures, but there were serious objections to these hypotheses. Willis had attributed it to an anomaly of ossification in which the developing ossific centre became divided into two parts. Mr West related case histories to show that progressive displacement could occur in adult life, and that dual lesions may occur, not necessarily in adjacent vertebrae. Displacement was usually associated with disc degeneration, but sciatic pain was caused more often by stretching of the nerve roots over projecting bone than by prolapse of disc material. In " pseudo-spondylolisthesis " displacement was permitted by insufficiency of the articular processes, either from congenital variations of their plane, or from degeneration of the articular cartilage. Displacement without laminal defect could occur even in young subjects as was illustrated by one of his cases. In the treatment of spondylolisthesis conservative measures such as fitting with a spinal brace were often adequate, but in some cases spinal fusion was well justified and gave good results. *Dr J. Freiberg* (Cincinnati, Ohio) described experiments to show that the elasticity of the annulus fibrosus was responsible for bulging of intervertebral discs on section and that the nucleus pulposus possessed no intrinsic elasticity. It was important to realise that a nerve root could be compressed in the foramen by thickening of the capsule of the posterior intervertebral joint. He had found that the severity of degenerative changes, as shown radiographically, bore little relation to the symptoms. *Mr A. L. Eyre-Brook* (Bristol, England) questioned the significance of structural skeletal changes in the causation of clinical symptoms. He believed that symptoms arose predominantly from soft tissue lesions and gave examples of prolapsed intervertebral disc in which the site of the prolapse was not that of radiographic changes. Patients with marked radiographic changes often had no symptoms. The lesson he had learnt from Dr MacNab's paper was that it might be wise to explore more thoroughly the intervertebral foramina in cases of sciatica in which a prolapsed disc was not found. *Dr Donald King* (San Francisco, California) said that Mr West's results from spinal fusion were gratifying and he believed that the operation would always give satisfactory relief if sound bony fusion could be ensured. He had reviewed his own results from spinal fusion, but found that bony fusion was secured in only 50 per cent of cases. He had, therefore, tried lumbar fusion through an abdominal approach in ten cases, but was disappointed with the results. He attributed failure to the fact that the graft lay in contact with avascular disc tissue, where it readily fractured and became absorbed. He had reverted to posterior fusion, but was using a more meticulous technique, with better immobilisation. *Mr Norman Capener* (Exeter, England) said that there was no single cause of spondylolisthesis, which simply meant slipping of the spine. He deprecated the use of the meaningless term " pseudo-spondylolisthesis "—either there was, or there was not, slipping. He recalled that reduction by flexion had been described many years ago by Jenkins. He himself had found, however, that reduction was more easily accomplished by hyperextension and had succeeded in reducing redisplacement in this way when flexion had failed. Nevertheless, he believed that efforts at reduction were fruitless because displacement always recurred. *Professor Merle d'Aubigné* (Paris, France) had found that his posterior spinal fusions were often unsuccessful. He had resorted to anterior vertebral fusion, inserting a bone graft and employing internal fixation by a long oblique

screw from fifth lumbar body to sacrum. Results so far were promising and he had been able to allow the patient to get up within two weeks. *Professor S. Friberg* (Stockholm, Sweden), in his own studies, had found similar changes and agreed with Dr MacNab's conclusions. *Dr MacNab*, closing, emphasised the difference between prolapsed intervertebral disc and disc degeneration. He agreed that radiographic changes were usually insignificant in the diagnosis of prolapsed disc. *Mr E. F. West*, closing, said that he preferred posterior fusion and insisted upon at least three months' immobilisation in a plaster bed. *Dr R. I. Harris* (Toronto, Canada), concluding, paid a tribute to the work done by Dr MacNab, which he felt had helped to correlate pathological changes with clinical findings. He said that the soft degenerate bulging type of disc was distinguished clinically by exacerbation of the pain on standing or jarring.

Filum terminale syndrome—*Dr G. Garceau* (Indianapolis, Indiana) described anatomical observations at operation in three patients with progressive spastic paralysis: in two there had been moderately severe scoliosis; the other had had a tuberculous spine in infancy. After laminectomy and incision of the dura in the thoracic region had failed to relieve the symptoms, exploration of the sacral region had revealed a tight filum terminale. After division of the structure the cut ends had sprung apart as if under considerable tension. There had been full recovery from paralysis in two cases and incomplete recovery in the third. He made no dogmatic claim, but suggested that tightness of the filum terminale might interfere with the function of the cord by traction. He had found a description of a similar pathological finding in a cadaver. *Dr Harold A. Sofield* (Chicago, Illinois) said that his discussion would be on theoretical grounds because he had no experience of similar cases. Three questions came to mind. 1) Had the spinal cord sufficient mobility, relative to the spinal canal, to allow its ascension after division of a tight filum terminale? 2) Might it not be that in the two cases with scoliosis, paralysis was due to the scoliosis itself? 3) In one case in which rest and traction had produced temporary relief before operation, how was it that section of the filum terminale could give permanent relief? He thought it necessary to investigate how much mobility between the spinal cord and the spinal canal was normally permitted by the dural attachments. *Dr Philip Lewin* (Chicago, Illinois) drew an analogy between Dr Garceau's cases and cases of delayed ulnar paralysis after elbow injuries. *Dr Robert Johnson* (Baltimore, Maryland) described his experience of cauda equina lesions. In one of his cases there had been a cystic tumour of the filum terminale. He had observed that in such a case the patient walked with a " straight-back gait " on a wide base, because flexion of the spine was impossible. He thought this gait was typical of filum terminale lesions. *Dr E. H. Wilson* (Columbus, Ohio) described cases in which flexion of the cervical spine and upper trunk aggravated the paralysis, presumably through traction on the cord. Improvement had followed rest in bed. He had fused the upper segment of the spine in such cases with good effect. *Dr Arthur Steindler* (Iowa City, Iowa) described his experience of paralysis complicating scoliosis. Some patients had recovered spontaneously, some after fusion, and some after laminectomy. He recalled that ascension of the spinal cord was prevented in some cases of spina bifida by adhesions, as mentioned by Recklinghausen. Dr Garceau's cases might be analogous. *Dr Garceau*, closing, emphasised that he was merely reporting anatomical observations and had insufficient knowledge of the condition to answer all the questions. It was conceivable that some of his patients might have return of symptoms. He thought it unlikely that scoliosis was the cause of paralysis in his cases because of the involvement, in one case, of the upper limbs. His patients had walked with a wide-based gait such as Dr Johnson had described, but the gait of his patients was noticeably spastic. He had not observed adhesions between the spinal cord and sacral area. He did not know how far the spinal cord would ascend after section of the filum terminale. Time alone would tell whether the cord ascended in his cases.

Ischaemic contracture local in the hand—*Dr Sterling Bunnell* (San Francisco, California) described the clinical features, pathology and treatment of this clinical entity, in which the intrinsic muscles were contracted. The condition occurred more frequently than had been recognised. It was caused by impaired vascularity in the hand, often from tight encasement within plaster or constricting bandages. It was distinct from Volkmann's ischaemic contracture but might co-exist with it. The deformed position was one of flexion at the metacarpo-phalangeal joints and extension at the proximal and distal interphalangeal joints. The first metacarpal was drawn medially towards the second, narrowing the thenar cleft. A diagnostic test was as follows. When the intrinsic muscles were tensed by pushing the metacarpo-phalangeal joints into extension, flexion of the fingers was impossible; but when the intrinsic muscles were relaxed by flexion of the metacarpo-phalangeal joints flexion of the fingers became possible. The condition should be prevented by taking care to avoid constriction of the limb after injuries and, if constriction was recognised, by its immediate relief. Corrective treatment was by operation. If some function of the intrinsic

muscles was retained advancement of their origins was advised, but if the muscles had lost their function tenotomy of the lateral bands to allow correction of the deformity was required. The contracted thumb cleft should be opened, contracted tissue excised and suitable skin grafts inserted. Treatment led to marked improvement but from the nature of the condition complete cure was not to be expected. A film showing the deformity and its operative correction was shown. *Dr Leo Mayer* (New York) paid a generous tribute to Dr Bunnell and expressed his gratitude to him. Bunnell's description of this deformity and its treatment was original and instructive. The points emphasised by Dr Bunnell were of prime importance. Dr Mayer re-emphasised the necessity for care in bandaging after operations and injuries. It was important that surgeons should recognise the possibility of improving the condition of the hand by advancement of the muscles or tenotomy of contracted structures. *Mr Guy Pulvertaft* (Derby, England) said that the condition that Dr Bunnell had described was not well recognised in Great Britain. He emphasised the need for prolonged post-operative treatment by elastic traction and exercises to prevent recurrence of contracture.

Care of the crippled child in the United States—*Dr A. R. Shands* (Wilmington, Delaware) said that there were 700,000 crippled children in the United States of whom 60 per cent were under treatment. Facilities now available included eighty-two hospitals for the sole care of children and a total bed capacity of 13,000, with an average occupancy of 75 per cent. The first children's hospital had been established at Boston, and the first in New York was the Hospital for Ruptured and Crippled, established in 1870; the most modern was that recently completed at Atlantic City. The most frequent types of case were: neuromuscular disorders, 36 per cent; congenital deformities, 29·7 per cent; developmental conditions, 27·7 per cent; infections, 6·6 per cent. Among individual conditions the most prevalent were poliomyelitis (22·2 per cent), cerebral palsy (13·8 per cent), and club foot (10·4 per cent); tuberculosis had relatively small incidence (2·1 per cent). The current cost of the programme had been estimated at approximately thirty million dollars per year. In most States it included educational facilities, vocational rehabilitation and training schemes. There were 220 recognised residencies for doctors studying problems of crippled children. Important requirements for the future included more adequate funds, social services, additional personnel, better co-ordination between the various agencies, better educational facilities and improved facilities for the care of patients with cerebral palsy. Dr Shands paid tribute to the memory of Michael Hoke who had contributed enormously to the relief of crippled children in America, and to the Shriners who, at the instigation of Hoke, had established their many hospitals for the care of children.

Capsular arthroplasty for congenital dislocation of the hip joint—*Dr Paul Colonna* (Philadelphia, Pennsylvania) recalled that his first capsular arthroplasty for congenital dislocation of the hip had been undertaken in 1930. Selection of cases was important. His best results had been in patients operated on between the ages of three to eight years. The operation was done in two stages. The first stage, which consisted of traction to bring the head down, was important and should not be omitted. At the second stage the acetabulum was reamed deeply, cutting through the cartilage down to bone; it was essential that the acetabulum be deepened adequately. The capsule was closed over the head which was then reduced into the acetabulum and the limb immobilised in plaster. When anteversion was marked rotation osteotomy at the supracondylar level was undertaken later. By creating a deep acetabulum and using the gliding mechanism between femoral head and capsule the operation achieved both stability and mobility. Dr Colonna showed a film of some of his long-term results; most patients had a good range of movement and excellent function.

Postero-lateral approach in treatment of congenital dislocation of the hip joint—*Dr Alexander Gibson* (Winnipeg, Canada) said that it was important to recognise congenital dislocation of the hip at birth and he advocated special instruction of midwives and obstetricians to this end. In the ordinary type of case, recognised after the first year, closed reduction had been the usual method, but he had been dissatisfied with the late results. He was tending to employ open reduction as the method of choice and he described his technique. After postero-lateral exposure of the joint the capsule was opened transversely. He had found that there was a diverticulum of the capsule extending upwards and that when its attachment to ilium was stripped downwards bone cells were displaced with it. After replacement of the head in the acetabulum the capsule was reefed so that the distal part lay below the proximal part. The limb was immobilised in plaster for three months. Advantages were: 1) reduction was more gentle than by closed manipulation; 2) operation ensured that the head was reduced through the capsular isthmus; 3) bone cells were displaced downwards with the capsule and promoted formation of bone at the roof of the acetabulum; 4) the period of immobilisation in plaster was short. *Sir Harry*

Platt (Manchester, England) said that his experience of open reduction had been with the conventional methods. He had recently reviewed sixty-four cases, in children under five, and had noted that the obstacle to reduction was, in order of frequency: large ligamentum teres, capsular isthmus, anomalous capsular attachment, and large femoral head. He had employed open reduction more frequently in recent years, but he did not consider that it should displace manipulative reduction as the standard method of treatment. He recalled that the postero-lateral approach to the hip was described, among other approaches, by Brackett of Boston many years ago. He preferred the anterior incision in young children when little reconstructive work was contemplated, but for older children requiring major reconstructions the postero-lateral incision was the method of choice. *Dr J. E. Milgram* (Brooklyn, New York) said that his personal experience with the Colonna method, admittedly employed as a last resort, had been disappointing, but he had had an opportunity of reviewing Colonna's own clinical cases and had found the results surprising and encouraging. He thought that the exact positioning of the deepened acetabulum at its normal location was difficult. He had formed the opinion that Colonna's method was valuable when successfully performed in proper cases. *Mr H. J. Seddon* (London, England) discussed the place of the Colonna method among other methods of treatment. He had been exercised as to what to do in patients too old for the ordinary methods of reduction, but too young for adult procedures such as cup arthroplasty. Dr Colonna had said that six to eight years was the upper age limit. He himself had tried the operation in older cases, but had had relatively disappointing results. The problem of what to do, if anything, between the age of eight years and adult life was still unsolved. *Dr G. W. N. Eggers* (Galveston, Texas) said that although he had been trained to use the anterior approach he now found that the postero-lateral approach gave better exposure for reconstructive procedures. *Dr F. E. West* (San Diego, California) warned that although the Colonna operation might be useful in unilateral cases it was hazardous in bilateral cases. He feared tragedies if the method was adopted too enthusiastically by inexperienced surgeons. *Mr J. B. Colquhoun* (Melbourne, Australia) said that he was not clear whether Dr Colonna employed the operation for all cases of congenital dislocation of the hip. He thought that the first line of attack should be by gentle manipulation, but that if this failed the Colonna arthroplasty might hold out the best hope of a successful outcome. *Dr Colonna*, closing, said that his method was not a universal operation for congenital dislocation of the hip. Careful selection of cases was necessary.

Diagnosis of shoulder lesions arising from injuries of the rotator cuff—*Mr V. H. Ellis* (London, England) recalled that Codman (*The Shoulder*. Boston 1934) had made a correct clinical diagnosis of torn supraspinatus in only twenty-one of his thirty cases submitted to operation. Codman had never operated upon a fresh case and his results after repair had been poor. These facts indicated the need for more accurate and early diagnosis. Mr Ellis suggested two diagnostic aids: 1) injection of procaine into the point of tenderness, and 2) arthrography. His practice in a suspected case of recent injury to the rotator cuff was first to inject procaine into the point of greatest tenderness; if after injection the patient's range of abduction was greatly increased it was considered that no major tear was present and that conservative treatment should be relied upon. If the range of abduction was not increased he proceeded to arthrography, injecting diodone solution through a needle inserted one inch in front of the acromio-clavicular joint. If the fluid entered the joint and ran out into the subacromial bursa, a tear of the rotator cuff was presumed, and if it ran out quickly the tear was probably large. Mr Ellis gave figures which suggested that both these diagnostic tests were reliable in a high proportion of cases. *Mr J. B. Colquhoun* (Melbourne, Australia) agreed that the clinical diagnosis of rotator cuff lesions was difficult. The employment of the local anaesthetic test had led to great improvement and Mr Ellis had shown convincingly that diodone arthrography was a further contribution towards early accurate diagnosis. *Dr T. Nicola* (Montclair, New Jersey) said that in practice there was no great problem in cases of massive rupture because operation was always clearly indicated. The difficulty of diagnosis arose with small or incomplete ruptures. In such cases he had used diodone arthrography and considered it of diagnostic value. He illustrated a case in which the patient was able to abduct 90 degrees after procaine injection but the subsequent arthrogram indicated a complete rupture. He emphasised the desirability for early operation when rupture was present. *Mr V. H. Ellis*, closing, stressed that in the procaine test abduction to 90 degrees was not sufficient to eliminate a diagnosis of major tear. A positive response should permit much greater abduction.

The area of fusion in scoliosis—*Dr John Cobb* (New York) said that less than 5 per cent of patients with idiopathic scoliosis required spinal fusion. It had been proved that adequate fusion would maintain correction of a curve. His paper was concerned mainly with the area and extent of fusion that should be undertaken. He recalled methods of measurement of spinal curves and

described how the permissible degree of correction should be determined. Thus, if flexibility was sufficient to permit full correction of the opposite curves, full correction of the primary curve, if possible, was permissible. In such a case fusion could extend between parallel vertebrae. If flexibility was not sufficient to permit full correction of the opposite curves (as was usual) fusion should not be between parallel lines; it should include the curve only, or the curve plus some or all of the compensation. If the permissible correction was not obtainable, maximal correction should be secured and fusion could include the curve only, or the curve plus all the correction, or a compromise could be made. If the scoliosis seemed relatively stable it was not usually necessary to fuse more than the curve.

Idiopathic scoliosis; prognosis, diagnosis and operative indications related to curve patterns and age of onset—*Mr J. I. P. James* (London, England) had confirmed Ponseti and Friedman's classification of types of scoliosis, relating prognosis to the pattern of the curve (Journal of Bone and Joint Surgery, 1950, **32–A,** 381). He had reviewed over 200 mature cases of scoliosis and sixty-seven immature cases, and had found that they fell into three main age groups: children, under three (infantile scoliosis); five to eight (juvenile scoliosis); and ten years to end of growth (adolescent scoliosis). He recognised the following patterns of curve. *Lumbar idiopathic scoliosis:* the onset was in adolescence and affected girls predominantly, the apex of the curve being at L.1. It was a benign deformity and clinical appearance was more favourable than the radiographs would suggest. Correction and fusion were not required. *Thoraco-lumbar idiopathic scoliosis:* the onset was usually in adolescence, with the apex at T.11 or 12. The deformity was intermediate in severity between those of lumbar idiopathic scoliosis and thoracic idiopathic scoliosis. Correction and fusion were seldom required. *Thoracic idiopathic scoliosis in juveniles and adolescents:* the apex was at about T.8; the curve tended to be severe and the clinical appearance was worse than the radiographs suggested. Curves beyond 70 degrees produced ugly deformity. Onset before ten years gave a bad prognosis. Correction and fusion were required relatively often. *Infantile thoracic scoliosis:* unlike other types this was more common in boys and the curve was often to the left. Except in rare instances in which spontaneous correction had been observed, deformity had always become severe by the age of ten. *Combined lumbar and thoracic idiopathic scoliosis:* the shoulders remained level and clinical deformity was relatively slight despite severe radiographic deformity. The onset was usually in adolescence although it might be earlier. None of his cases in this group had yet required correction. In the *diagnosis* of the type of deformity the site of the primary curve was best determined clinically. *Dr J. R. Moore* (Philadelphia, Pennsylvania) said that he found difficulty in following Dr Cobb's thesis in some details. He doubted whether a curve could be determined as stable before the end of the growth period. *Dr C. N. Lambert* (Chicago, Illinois) warned that over-simplification by classifying curves into groups had potential dangers. It was valuable if used simply as a method of classification, but should not be applied rigidly in the choice of treatment; each case should be judged on its merits. Even a curve that had not progressed for years might suddenly begin to increase. He agreed with Mr James that fusion should not usually be undertaken under the age of ten years. *Mr H. Osmond-Clarke* (London, England) emphasised the debt owed to American workers on scoliosis, mentioning Dr Steindler and Dr Risser; especially were we indebted to Dr Cobb, who had not only shown us what to do, but had made it appear easy. He praised his discretion in completing an extensive study before publishing any results. He considered that the determination of prognosis from consideration of the pattern of a curve was a most useful contribution. Despite ability to prognosticate, however, he remained depressed because we were unable to handle the problem of scoliosis developing in a young child. He hoped that improved results might follow Nachlas and Borden's experimental work on arresting growth at the epiphysis on the convex side (Journal of Bone and Joint Surgery, 1951, **33–A,** 24). *Dr John Cobb,* closing, said that his experience showed that few idiopathic scolioses of the type that he classed as "stable" ever progressed much after the age of fifteen or sixteen years. There had been a tendency to do less spinal fusions as knowledge increased as to when to do it and when not to do it.

Ulnar neuritis from ganglion pressure—*Mr H. J. Seddon* (London, England) described clinical research into painless motor ulnar palsy with sparing of the hypothenar muscles, arising after single or repeated injury. This paper is published in full in this number of the Journal (page 386).

Etiology of carpal tunnel compression of the median nerve—*Mr K. I. Nissen* (London, England) discussed the cause of carpal tunnel compression of the median nerve when no obvious cause for narrowing of the carpal tunnel such as osteoarthritis or Léri's pleonosteosis existed. In several cases he had made extensive dissections to determine any significant pathology in the palm. He had found thickening of the flexor tendon sheaths suggesting a chronic non-specific

proliferative tenosynovitis with effusion. He submitted that such a condition might reduce the capacity of the carpal tunnel sufficiently to compress the median nerve. He showed a film of an operation for removal of this thickened synovial tissue. He had observed that in these cases there was slight limitation of extension and flexion of the fingers and he regarded this as an important diagnostic sign. *Dr Robert Joplin* (Boston, Massachusetts) said that the condition described by Mr Seddon might be more common than had been recognised. He had met similar cases, but there had been sensory changes as well as motor. He asked whether enlargement of a ganglion causing initial motor paralysis might not ultimately also cause sensory paralysis. *Dr Leo S. Lucas* (Portland, Oregon) said that any condition decreasing the capacity of the carpal tunnel might lead to median nerve compression. In many cases the cause had been obscure. He suggested that prolonged gripping of objects with the wrist flexed, as was entailed in certain types of work, might lead to median compression in an otherwise normal wrist. Conservative treatment by rest and adjustment of employment might be effective. Chronic tenosynovitis was a possible cause of nerve compression, but his histological studies had failed to show significant pathology. Further studies were needed. *Mr Robert Roaf* (Liverpool, England) regarded the two preceding papers as important in offering a new outlook in these syndromes which formerly had often been regarded as arising from rheumatism or some obscure neurological lesion. He thought that early diagnosis was difficult and suggested a period of splintage as a diagnostic measure. He had found that thickening of the tendon sheaths was fairly frequent; limitation of finger movements was an important sign, but care should be taken not to confuse it with that resulting from rheumatoid arthritis. *Mr H. J. Seddon*, closing, said that ganglia arising from carpal joints usually spared the sensory branch because of its position. Early diagnosis was facilitated by the typical neurological signs of ulnar motor paralysis with sparing of the hypothenar muscles.

Role of sympathectomy in the treatment of causalgia—*Mr Roland Barnes* (Glasgow, Scotland) had examined the current theories of the pathogenesis of causalgia and had attempted to explain why sympathectomy was effective, as it was in most cases. His observations were based on forty-eight cases. He recalled that causalgic pain was of burning type, severe, persistent, spreading beyond the territory of the injured nerve, and aggravated by physical and emotional stimuli. The nerve lesion was almost always an incomplete lesion of the median nerve or its roots or branches; or of the medial popliteal nerve or its roots or branches. With few exceptions the lesion was above the knee or elbow and in his series all had been caused by missiles. The results were better after pre-ganglionic section of the sympathetic than after post-ganglionic section. It was tempting to attribute relief after sympathectomy to section of pain pathways in the sympathetic nerves, but this theory was untenable because: 1) no sensory changes followed sympathectomy; 2) in cauda equina lesions (below the sympathetic outflow) there was complete sensory loss despite intact sympathetic fibres. These and other observations proved that there were no pain pathways in the sympathetic system. Lewis had suggested that the effect of sympathectomy was by vasodilation of peripheral vessels, but vasodilation induced by other means did not relieve causalgic pain. The most reasonable hypothesis was that causalgia arose from short-circuiting of efferent impulses in the sympathetic to afferent sensory nerves, the impulses travelling proximally or peripherally in the sensory nerve. *Mr D. Lloyd Griffiths* (Manchestr, England) suggested that there might be more than one cause of causalgia. Mr Barnes's hypothesis explained many cases but it did not account for causalgia after complete nerve lesions or in amputated limbs. Theoretically sympathectomy should cure all cases, and the fact that it did not led him to infer that the extent of the operation was inadequate. *Dr I. W. Nachlas* (Baltimore, Maryland) agreed that failure to achieve universal cure after sympathectomy might be accounted for by insufficient extent of operation, but even after more extensive sympathectomies the results were not uniformly good. Possibly causalgia was not a single entity. This suggestion was supported by the observation that some causaligc limbs were cold and some hot; in some the bones were normal radiographically, and in others they were porotic. *Mr Barnes*, closing, agreed that there were difficulties in explaining causalgia after complete nerve division.

Tuberculosis of bones and joints—*Dr David Bosworth* (New York) reported preliminary trials with the nicotinamide group of chemicals in the treatment of skeletal tuberculosis. He had used "Rimifon" (isonicotinyl hydrazide), which was readily available, and "Marsilid," a derivative not yet generally available. Marsilid had been found more effective than Rimifon. The effects were dramatic and included fall of temperature, gain of weight, marked euphoria, rapid relief of pain, and improved healing of wounds. Within the eight months' period of the investigation a high proportion of the patients treated had been able to return home. In a few cases toxic effects had been observed; they were mainly neurological disturbances and included one case of psychosis. He ascribed the beneficial effects of the drugs partly to direct bacteriostatic action and partly to their

effect on the body tissues. *Dr A. de F. Smith* (New York) said that his own experience of these new drugs was too short to permit analysis. Dr Bosworth's cases at Seaview Hospital included some of the worst cases of skeletal tuberculosis and the results so far were impressive. It seemed certain that nicotinamides had a direct effect on the tubercle bacillus as well as improving the nutrition of the body and the mental well-being. The margin of safety seemed sufficient to permit good results without serious risk of toxic effects. It was not yet known whether the tubercle bacillus developed resistance to the drug. He did not believe that these new drugs would supplant surgical measures, but they would permit safer and earlier surgical intervention.

Problems of neurofibromatosis as related to orthopaedic surgery—*Dr H. R. McCarroll* (St Louis, Missouri) had studied 109 patients with orthopaedic disabilities associated with other signs suggestive of congenital neurofibromatosis. He classified the manifestations into: cutaneous, subcutaneous, skeletal, vascular, and lymphatic types of involvement, illustrating each by case records. *Cutaneous* involvement included café-au-lait patches, naevus lateralis and verrucous changes. *Subcutaneous* manifestations were local thickenings, diffuse thickenings and plexiform masses. Important *skeletal* changes were scoliosis, hypertrophy of bone, bone cysts, shortening, congenital pseudarthrosis and melorheostosis. *Vascular* manifestations included haemangioma and venous dilation. *Lymphatic* changes might result primarily from the disease or they might be secondary. The causal relationship between the neurological lesion and the clinical findings was obscure. *Dr Joseph Buchman* (New York) criticised the diagnosis of neurofibromatosis in all such cases. He considered that the diagnosis was made too readily in cases in which skeletal changes co-existed with café-au-lait patches. Many otherwise normal persons had café-au-lait patches, and orthopaedic disabilities might be coincidental. *Mr J. Fairbank* (Cambridge, England) asked whether Dr McCarroll could explain the pathogenesis of scoliosis in neurofibromatosis and whether he recognised any relation between neurofibromatosis and polyostotic fibrous dysplasia. *Mr L. Michaelis* (Stoke Mandeville, England) said that severe scoliosis from neurofibromatosis was not uncommon. Deformity might be extreme and might cause paraplegia. *Dr McCarroll*, closing, did not insist that all the manifestations described were caused by neurofibromatosis. He believed that polyostotic fibrous dysplasia might be a manifestation of neurofibromatosis though he had encountered none in his series.

Results of excision of the patella—*Dr H. H. Boucher* (Vancouver, Canada) reported the results of excision of the patella in 105 patients who had been followed up for two years. The operation had been done for fracture, chondromalacia of the patella, and recurrent dislocation of the patella. He stressed the difficulty of diagnosing chondromalacia in its early stages. Painful crepitus at the beginning of extension movement was a useful sign. He believed that excision of the patella was indicated, if the disability justified it, as soon as the diagnosis of chondromalacia had been established. The results were good in almost all cases. Most patients were well satisfied, but some aching in the knee was a common residual complaint. Complications had included incomplete rupture of the quadriceps tendon in two cases, and complete rupture in two cases. Reformation of bone within the tendon might cause renewed pain.

Excision of the patella—*Mr R. H. Sewell* (London, England) reported results of excision of the patella in sixty-four cases treated at the Royal National Orthopaedic Hospital, mostly for osteoarthritis, recurrent dislocation and rheumatoid arthritis. In *osteoarthritis* relief of pain had been striking when the arthritis was confined mainly to the patello-femoral compartment, but some relief had been gained even when tibio-femoral arthritis was also present. Full extension was usually regained; slight limitation of flexion was common. The patient's co-operation in exercises was important. In *recurrent dislocation* of the patella further subluxation occurred in two out of thirteen cases. In *rheumatoid arthritis* results were mostly poor. Complications had included slight sepsis, popliteal nerve palsy, and intra-articular adhesions. A usual residual disability was inability to sit for long periods with the knee flexed, and aching in the joint was common. He concluded that the operation was of value for patello-femoral osteoarthritis in co-operative patients, that it was not universally successful in recurrent dislocation, and that it was inadvisable in rheumatoid arthritis. *Dr E. F. Cave* (Boston, Massachusetts) said that early diagnosis of chondromalacia of the patella depended upon wider exploratory incisions that allowed inspection of the articular surface of the patella. All were agreed that the patella should be excised for comminuted fractures. He preferred reconstructive surgery for transverse fractures, but agreed that excision was justified for recurrent dislocation. For chondromalacia he preferred patelloplasty to complete excision. *Mr J. A. Bond* (Sydney, Australia) said that after careful excision of the patella full extension could be restored, but discomfort and aching were common. He had been satisfied with the results of excision for gross degenerative lesions of the patella.

Posterior subtalar fusion in the treatment of fractures of the calcaneum—*Mr I. Lawson Dick* (Edinburgh, Scotland) attributed disability after fracture of the calcaneum to: 1) subtalar arthritis, and 2) secondary stiffness of the foot. Pain from arthritis could be prevented by early subtalar arthrodesis whenever the subtalar joint was distorted. Stiffness of the foot could be prevented by avoiding immobilisation. The preferred method of fusion was that described by Gallie (Journal of Bone and Joint Surgery, 1943, **25**, 731). After operation no form of immobilisation was employed. Swelling was prevented by bandaging and active exercises were practised from the beginning; walking was deferred for eight to ten weeks. Nine patients thus treated had all returned to their former work. *Dr R. I. Harris* (Toronto, Canada) agreed with the principle of early fusion for disorganised subtalar joint. He emphasised the need to correct deformity of the foot, especially varus deformity. Heaping up of bone around the lower end of the fibula might cause symptoms requiring trimming of the excess. In spontaneous subtalar fusion he had observed the gradual development of osteoarthritis of the midtarsal joint. He thought that this might happen after operative fusion. *Mr E. F. West* (Adelaide, Australia) thought that Ivar Palmer's reconstructive operation on the calcaneum gave good results in selected cases. *Dr L. T. Peterson* (Washington, D.C.) agreed that early fusion was well worth while when the subtalar joint was deformed. Many would prefer triple arthrodesis and many would advise early walking in plaster.

Orthopaedic aspects of leukaemia—*Mr D. Lloyd Griffiths* (Manchester, England) said that obscure bone lesions might sometimes prove to be leukaemic in origin. Acute or subacute leukaemia was relatively common in children and bone manifestations were frequent. Recognition was difficult because the typical blood picture developed only terminally, though marrow puncture might be diagnostic earlier. He had encountered eleven cases of skeletal involvement in children between two and sixteen years of age. The symptoms included pain in the back, sciatica, pain in the hip or other joints, pain in the bones and feet, and, in one instance, paraplegia after a fall. In many cases the only early pointer to the true underlying condition was anaemic pallor. Bone changes were of three types, destructive, formative and mixed. Destructive changes included translucent zones in the metaphyses, focal erosions and diffuse infiltration by the leukaemic process. Destruction implied increase of red marrow at the expense of bone tissue. Formative changes were subperiosteal ossification and, rarely, sclerosis, as in a vertebral body. Infarction of bone might occur. It was not always obvious in radiographs because walking was limited and life was short, so that collapse did not always occur. Mr Griffiths concluded that unexplained limb pains in pale children should be suspected as a manifestation of leukaemia. *Mr H. Jackson Burrows* (London, England) illustrated the variable progress and prognosis. If the distal parts of the limbs escaped the radiological marks of otherwise widespread destruction, leukaemia might be suspected. Chronic leukaemia was often mistaken for post-menopausal or senile osteoporosis of the spine, and might be almost indistinguishable except by marrow biopsy; but any unusual degree of concomitant extra-spinal rarefaction, as exemplified by protrusio acetabuli, should arouse suspicion. *Dr Ernest Falconer* (San Francisco, California) said that the incidence of skeletal changes was high in children and might be 10 per cent in adults. This was not surprising because the condition affected the bone marrow. He emphasised the importance of marrow aspiration and he advised routine bone surveys in leukaemia.

Posterior peripheral detachment of the lateral meniscus—*Mr E. A. Jack* (Edinburgh, Scotland) described a tear of the postero-lateral part of the lateral cartilage behind the hiatus for the popliteus muscle. He regarded it as a clinical entity. He described the anatomy of the lateral cartilage and referred to Last's description of the role of the popliteus muscle (Journal of Bone and Joint Surgery, 1950, **32-B**, 93). The history was usually of postero-lateral pain on extension of the knee after squatting. There were attacks of locking with easy reduction by straightening and pulling the limb. There was tenderness over the cartilage behind the lateral ligament. At operation the cartilage came away into the centre of the joint as soon as the popliteus hiatus was reached; this ready-made detachment of the posterior part of the cartilage made the operation easy. *Mr I. S. Smillie* (Dundee, Scotland) thought this clinical entity was already recognised. He had found it in approximately 12 per cent of lateral meniscectomies and 4 per cent of all meniscectomies. *Dr D. H. O'Donoghue* (Oklahoma City, Oklahoma) said that Professor Last's description of the function of the popliteus had been a new concept to him. The lesion described by Mr Jack was familiar to him. He had formerly classified it with posterior tears or bucket handle tears. He thought the popliteal hiatus might limit the spread of the tear forwards. *Dr J. Valls* (Buenos Aires, Argentine) recognised the lesion as "popliteus hiatus syndrome." *Mr Jack*, closing, said that the incidence of the lesion in his series was similar to that found by Smillie, namely 12 per cent about. Since the tear was through vascular tissue it might heal spontaneously with immobilisation.

Clinical cases—At a meeting at the country branch of the Royal National Orthopaedic Hospital and Institute of Orthopaedics a wide variety of clinical cases and scientific exhibits was shown. Notable among the clinical cases were examples of replacement of major parts of the long bones by acrylic prostheses, shown by Mr H. Jackson Burrows and Dr J. T. Scales. This series included patients in whom the lower limb had been amputated and an acrylic prosthesis representing the proximal half of the femur inserted to provide a useful stump; a woman whose upper half of humerus had been excised for sarcoma and replaced by a prosthesis; and a youth whose knee joint, excised for fibrocystic disease of the lower end of the femur, had been replaced by a prosthesis which incorporated a movable knee joint. Results were encouraging, but the movement that had been regained was only fair; no claims have been made as to the probable long-term results.

An impressive series of muscle transplants for paralytic lesions, including several successful examples of Clark's pectoral transplant for biceps paralysis, was shown by Mr H. J. Seddon and Mr D. M. Brooks. Mr K. I. Nissen showed cases of Judet arthroplasty of the hip; and Mr A. T. Fripp demonstrated patients with club feet treated by the Kite technique. Other cases included paraplegia in tuberculosis of the spine (Mr H. J. Seddon), ischio-femoral arthrodesis (Mr J. A. Cholmeley), scoliosis, hand surgery, and epiphysial arrest (Mr J. I. P. James), and congenital dislocation of the hip (Mr H. J. Seddon and Mr D. Trevor). Scientific exhibits included a demonstration of measurement of anteversion of the femoral neck (Mr J. Shelswell), demonstration of radiography (Dr Campbell Golding and Dr E. Allen) and of photography (Mr R. J. Whitley), low blood pressure anaesthesia (Dr G. E. H. Enderby), the effect of cortisone on epiphysial growth and on the healing of bone and muscle (Dr C. J. Hadfield) and synthetic materials (Dr J. T. Scales). Other research projects illustrated were: bacteriological aspects of skeletal tuberculosis (Dr C. H. Lack); bacterial chondrolysis (Dr C. H. Lack); biochemical experiments in ossification (Dr T. F. Dixon); and spinal cord changes in poliomyelitis (Mr W. J. Sharrard). The work of the metabolism unit was described by Drs Nassim, Stevenson and Dixon. Mr F. Hedden demonstrated the Nangle method of suspending plaster beds, Mr W. H. Tuck showed orthopaedic appliances, and Sister Donlon gave examples of plaster technique. On the final day of the meeting further clinical demonstrations took place at the larger London undergraduate teaching hospitals, including the London, St Bartholomew's, Guy's, the Royal Free, St Thomas's, the Middlesex and King's College Hospitals.

CLINICAL DEMONSTRATIONS

Royal National Orthopaedic Hospital *and Institute of Orthopaedics, Stanmore*—On a bright sunny afternoon on Tuesday, July 1, hundreds of surgeons invaded the country branch of the Royal National Orthopaedic Hospital where every ward was open to inspection. The patients had small cards summarising history and treatment strung round their necks with all relevant x-ray films in viewing boxes at the side. The only difficulty was that no more than a few hours was available for clinical studies that might well have engaged several weeks. The demonstrations included: the effect of cortisone on experimental fractures, epiphysial growth and the healing of muscle by Dr C. J. Hadfield; bacteriological aspects of skeletal tuberculosis, and bacterial chondrolysis by Dr C. H. Jack; low blood-pressure anaesthesia by Dr G. E. Enderby; spinal cord changes in poliomyelitis by Mr W. J. Sharrard; experimental work in the application of plastics in orthopaedic surgery by Dr J. Scales; measurement of anteversion in congenital dislocation of the hip by Mr Shelswell; replacement of bone by plastic prostheses by Mr H. J. Burrows; the Kite technique in the treatment of club foot by Mr A. T. Fripp; Judet arthroplasty of the hip by Mr K. I. Nissen; adolescent coxa vara by Mr P. H. Newman; pectoral transplants for biceps paralysis, fascial slings for trapezius paralysis, preventive tendon transplants in the foot, and nerve grafts by Mr H. J. Seddon; ischio-femoral arthrodesis of the hip joint by Mr J. A. Cholmeley; treatment of skeletal tuberculosis with streptomycin by Dr H. Stevenson; treatment of scoliosis, and the surgery of the hand by Mr J. I. P. James; congenital dislocation of the hip by Mr H. J. Seddon and Mr D. Trevor; paraplegia in tuberculosis of the spine by Mr H. J. Seddon; suture of the extensor pollicis longus tendon by Mr D. Trevor; biochemical experiments in ossification by Mr T. F. Dixon; and cold vasodilation by Mr G. W. L. Bonney.

Medical Schools of London Teaching Hospitals—Clinical programmes for smaller groups of surgeons were arranged on Friday, July 4, at Middlesex Hospital, St Bartholomew's Hospital, St Thomas's Hospital, Royal Free Hospital, Guy's Hospital, King's College Hospital, and the London Hospital.

Middlesex Hospital—The demonstrations included: angiography in the diagnosis of bone tumours by D. Sutton; results of decompression of the carpal tunnel for median nerve symptoms by J. Golding; compression arthrodesis of the knee by P. R. N. Kerr; Chandler's lumbo-sacral fusion with bone-bank rib by P. H. Newman; fifty cases of osteoclastoma by Philip Wiles; and a film on clinical applications of the functional anatomy of the low back by Silver, Golding and Floyd.

St Bartholomew's Hospital—Sir James Paterson Ross and Mr J. B. Kinmonth gave a demonstration of investigations into various forms of arterio-vascular disorder; Dr E. Scowan and Dr Archer demonstrated clinical investigations of metabolic and endocrine diseases of the skeleton; and as well as many clinical discussions and presentation of films there was a display of the archives of the hospital including specimens, writings and publications by Percival Pott, Paget, Elmslie and Gauvain; and of the well known Hogarth mural on the Grand Staircase of the hospital.

Royal Free Hospital Medical School—A clinical and research programme was presented. The research studies included: the blood supply of joint structures, demonstrations of the circulus articuli vasculosus of John Hunter, fibular rotation in relation to movements of the ankle joint, contribution of the metacarpo-phalangeal joint of the thumb to opposition, prenatal development of the intervertebral disc in man, injury of the intervertebral disc by lumbar puncture, relative length of the first and second metatarsal bones, calcar femorale in relation to trochanteric fractures, collagen deposition in repairing tendons, ossification in regenerating rat tendon, regeneration of devascularised muscle and its subsequent innervation, studies of recovery of function after peripheral nerve injuries in man, re-innervation of denervated muscle by the implantation of a " foreign " muscle nerve, use of muscle grafts, recovery of sensibility in full thickness skin grafts, and electromyographic studies of the activity of lower limb muscles in man during standing. These contributions were by C. H. Barnett, J. R. Napier, M. Harty, D. V. Davies, the late A. Peacock, A. H. Baker, D. W. James, R. C. Buck, J. T. Aitken, D. M. Allbrook, D. D. B. Morris, R. E. M. Bowden, J. Whillis, D. A. Sholl, D. Russel Davies, F. K. Saunders, F. G. Ellis, A. Nightingale and J. Joseph. There was a demonstration of strain gauge methods in anatomical and physiological research from the Working Efficiency Section of the Medical Research Council Unit for Research on Climate and Working Efficiency from the Department of Human Anatomy, Oxford, by H. D. Darcus, R. J. Whitney and N. Salter.

The London Hospital—At the London Hospital demonstrations included groups of patients illustrating the Putti-Platt repair of recurrent dislocation of the shoulder by H. Osmond-Clarke; treatment of femoral neck fractures in the aged by O. Vaughan-Jackson; spinal osteotomy by W. Alexander Law; and recurrent *forward* dislocation of the ankle by Sir Reginald Watson-Jones. There were demonstrations of tumours of bone and calcium metabolism by Professor D. Russell; management of bone infection by Professor Bedson; results of deep x-ray therapy for bone tumours by Dr Shanks; excision of the trapezium for osteoarthritis by H. A. Pearce; unusual Charcot's joints by M. B. Devas; and treatment of Dupuytren contracture by C. G. Attenborough. A radiographic demonstration of sky-line views of the carpal tunnel, olecranon and patella; high-voltage radiography of infected bones; bone-length measuring without special apparatus; studies of calcaneo-navicular bars, cervical spondylosis and strain-films of fractures; and radiographic control of the treatment of scoliosis was given by Miss Vaughan in the radiographic section of the Orthopaedic and Accident Department; and Mr Ruddick gave a demonstration of theatre cinematography.

FILM DISPLAYS

The demonstration of cinematograph films on surgical and scientific subjects which continued throughout the week concurrently with the scientific programme included:

Treatment of spondylolisthesis by anterior route	Professor Merle D'Aubigné, Paris
Use of radio-active phosphorus in the detection of early avascular necrosis of the femoral head	G. P. Arden, Windsor
Spinal osteotomy for ankylosing spondylitis	H. Osmond-Clarke, W. A. Law, London
Conservative operation for paralytic deformities	Professor B. McFarland, Liverpool
Lambrinudi drop foot and reversed drop foot operations	T. T. Stamm, London
Surgical approaches to the hip	LeRoy Abbott, San Francisco
Surgical approaches to the knee	LeRoy Abbott, San Francisco
Surgical approaches to the ankle	LeRoy Abbott, San Francisco
Capsular arthroplasty for congenital dislocation of hip	Paul Colonna, Philadelphia
Motivation of children with cerebral palsy	Plato Schwartz, New York
Steindler transfer of the elbow flexor muscles	Leo Mayer, New York
Rehabilitation—film of historic interest prepared in 1927	Reginald Watson-Jones, London
Rehabilitation in the Royal Air Force	By permission of D.G.M.S., R.A.F.
Treatment of Injuries of Extensor Tendons of the Hand	R. G. Pulvertaft, Derby
Treatment of Injuries of the Flexor Tendons of the Hand	R. G. Pulvertaft, Derby

BRITISH ORTHOPAEDIC ASSOCIATION

EXECUTIVE SESSION

An executive session of Fellows was held in the Senate House of the University of London on July 3, 1952, with Sir Reginald Watson-Jones, president, in the chair.

Honorary Fellowship of the Association was conferred upon the president of the Canadian Orthopaedic Association and upon Dr William Rogers, of Boston, U.S.A.

Dr Johannes Mortens, Denmark, was elected a Corresponding Member.

The Robert Jones Medal and Prize for 1951 were awarded to Mr P. K. Duraiswami for his essay entitled "Experimental Causation of Congenital Skeletal Defects and its Significance in Orthopaedic Surgery."

The executive nominated Professor Bryan McFarland as president of the British Orthopaedic Association for 1953–54; Philip Newman as secretary; and V. H. Ellis as treasurer. Voting on these nominations will take place at the autumn meeting.

ANNUAL MEETING 1952

The annual meeting of the Association will be held in Sheffield on October 24–25, 1952.

ROYAL SOCIETY OF MEDICINE

SECTION OF ORTHOPAEDICS

Surgery and the surgeon—*Mr Philip Wiles*, in his Presidential Address delivered on March 14, 1952, discussed the nature of surgery, the special contribution of orthopaedic surgery and the training of surgeons. *The nature of surgery* was such that every operation, however constructive its purpose, was a destructive procedure: cutting implied destruction of tissue and called upon the body to heal the damage. To do harm in order that good might result was an unsatisfactory basis for action, however needful. New and better operations, to which so much thought and energy were devoted, were but a temporary expedient, and other methods of treatment—and indeed the eventual abolition of surgery—should ever be the surgeon's aim. The longest step towards the dethronement of the surgeon had been in the treatment of infection, but even here surgery was still often essential, especially after injury. The prevention of some congenital deformities seemed in sight with the discovery of the part played by disturbances in the maternal environment. Trauma remained the most unhappy aspect of the surgical field. Great as had been the advances in treatment, they could not keep pace with the increasing destructiveness of machinery and especially of that devoted to war. In spite of progress towards controlling surgery in a few directions, the number of surgical operations performed continued to increase enormously—by 50 per cent at the Middlesex Hospital in the last decade—because of increased technical skill and especially because the physician, physiologist and chemist had made surgery safer.

The contribution of orthopaedic surgery—Mr Wiles held that orthopaedics had gained its place as a special branch of surgery because of the devotion of its exponents to the preservation and restoration of function ever since Andry coined the awkward name. Andry in the eighteenth century had been concerned chiefly with the correction of deformities in children; in the nineteenth century, the orthopaedic surgeon had come to treat also tuberculous disease of bones and joints; and in the twentieth century, he had added to his field all diseases of bones and joints, of the muscles and nerves controlling them and of the skin covering them. Under his nurture the care of fractures, plastic surgery, peripheral nerve surgery and hand surgery had developed so greatly that already they were separating as specialities of their own. In spite of its long standing, orthopaedic surgery had not become fledged until after the first world war or of adult stature until after the second. The increasing industrialisation of the nineteenth century had brought with it a full tide of accidents but no well organised treatment. The first world war had proved the turning point. The enormous casualties, with no proper organisation to deal with them, had been Robert Jones's opportunity. The adult cripple at last came into orthopaedic hands, and for the first time the restoration of function became the principal and almost the only aim of treatment. However, the patient still reached the orthopaedic surgeon after the disability had become established; the primary treatment was in other hands. It was not until after the first war that the surgeon who was to treat the failures was conceded a say in the primary treatment and allowed to try to reduce their number. Thus, because the full restoration of function was his ideal, the orthopaedic surgeon had come to embrace within his sphere all injuries and disabilities of the spine and limbs.

During the present century, technical advances had greatly widened the horizon not only of all surgery but of functional restoration also. This implied a special attitude of mind in the surgeon

and his assistants, which had to be imparted to the patient. Without the aids implied by this approach, modern operations would be useless. Unless able to prescribe treatment in a first-rate physiotherapy service, the surgeon could not honestly advise and undertake operation. Orthopaedic surgeons, who had been foremost in initiating and developing rehabilitation services, did not grudge administration by others, but the right to prescribe—and the ability to prescribe—must be preserved.

The collaboration demanded of an orthopaedic patient in his own treatment should extend to the decision whether an operation should be done at all—the judgment whether the likely relief was commensurate with the inevitable danger, inconvenience and suffering.

The training of surgeons—The basic training of an orthopaedic surgeon must be in general surgery, but it was difficult to see how this was to be obtained now that the general surgical wards no longer contained a representative cross-section of surgical practice. It should take place in the university centres, with their atmosphere of criticism and scientific research. In the past, undergraduate teaching had been carried out in the general wards, and by general surgeons, because the wards contained varied clinical material and because the great surgeons and teachers were general surgeons. Now the general wards had lost their variety and many specialist surgeons were of no less stature than their colleagues. The time had come when an appointment as teacher should go to the man most suited to fill it, whether he be in charge of a general surgical or a specialist ward. The fundamentals were common to most specialities, as were the general methods of examination of the patient, and it should not matter if they were demonstrated with particular reference to one set of organs or another. What did matter was that the surgeon himself had been properly trained in surgery and had an outlook broad enough to comprehend the surgical field. Not all surgeons had enough interest in teaching or an outlook fitted for this work. The material available to the student might be no more restricted in an orthopaedic ward than in the ward of a general surgeon whose first interest happened to be diseases of the lower bowel or of the genito-urinary system. Custom alone excluded the specialist surgeon from basic teaching. The next, the registrar, stage in a surgeon's training, namely general surgical training, undertaken up till now by the general surgeon, had become increasingly difficult as general surgery had become more restricted in scope. The advantages of serving this period in apprenticeship to one chief was becoming outbalanced by the restriction in experience. We seemed to be driven, *faut de mieux*, to a " rotating " system whereby the trainee would spend, in each of several surgical departments, a time that was lamentably brief for economic reasons. The final stage, that of specialist training, was much the easiest to arrange at present. So far as possible, it should be carried out at a university centre, with its continual fire of criticism. The longest possible time should be spent with one chief.

Another problem raised by the increase in specialisation was to meet the increased demand for more in-patient accommodation for the various specialities whilst maintaining a proper balance in the hospital. The number and variety of operations had not increased nearly so greatly in the general surgical field, in its ordinary meaning, as in the specialities. Although the bed accommodation for the specialities had increased but little, the general beds had gained to the extent that the specialist cases were no longer admitted to them. Specialist work was therefore insufficiently represented at teaching hospitals of the university centres, to the detriment of students of all types. Experience had shown that this difficulty could not be satisfactorily overcome by the acquisition of beds at peripheral hospitals; another solution must be sought.

Mr Wiles believed that the problems of providing a comprehensive training in surgery and of restoring a balance of beds more accurately representing present day surgical practice, would both be helped if in appropriate cases the specialist surgeon were given charge of beds now allotted to general surgery, and if the specialists fitted to do so were to join in the basic training of students. The true general surgeon, in the sense of the surgeon who could advise on and carry out the treatment of every complaint of every part of the body, was a man of the past. He might flourish yet awhile in sparsely populated areas, but he had gone from the centres of learning. We had reached the time when the leader, and in consequence the teacher, in our profession was not necessarily the general surgeon, but *Surgeon*, the surgeon with a capital S. A man might specialise in diseases of the thyroid, of the stomach, or of bones and joints; or he might prefer the upper respiratory passages, or he might have an affinity for the uterus or for the rectum, but first and foremost he must be a Surgeon.

The speciality of orthopaedic surgery had always been in a state of flux, extending pseudopodia like an amoeba and again withdrawing them. But it had not digested and engulfed particles of surgical fare. They had remained for a period of gestation, and then been given forth again as developed specialities. The surgical specialities must always be changing, dividing and re-uniting to suit the precise needs of time and place, but for as long as surgery was necessary, the specialist must remain first and foremost a Surgeon.

SECTION OF PHYSICAL MEDICINE

The summer meeting of the Section of Physical Medicine was held jointly with the Section of Epidemiology and Preventive Medicine at Garston Manor Rehabilitation Centre on June 11, 1952. Dr C. J. S. O'Malley, medical director of the centre, gave an account of its development, under the auspices of the North-West Metropolitan Regional Hospital Board, since its inauguration a year ago. At present the centre, which is situated in delightful and well wooded surroundings, accommodates fifty-five in-patients and about twenty out-patients who are brought daily from hospitals in the vicinity, but there is room for considerable expansion. The policy has been to include a number of short-term cases among the weekly admissions in order to maintain a reasonably rapid turnover and thus to encourage morale and enthusiasm. The emphasis is on group exercises, with redevelopment of muscles by active use, but individual treatment is given in appropriate cases, especially in the early stages. "Work therapy," in which the patient uses his muscles and joints by doing the type of work to which he has previously been accustomed, has recently been introduced. The results in the cases shown were impressive, as were the excellent spirit and enthusiasm of the patients and the general atmosphere of the centre. Compensation problems, engendered by the present structure of the law and fostered—perhaps unwittingly—by lawyers, remain a serious obstacle to recovery in some cases. As the medical director puts it, "a man will never recover fully if he is likely to lose money by doing so."

REGIONAL ORTHOPAEDIC CLUBS

SOUTH-EAST METROPOLITAN REGIONAL ORTHOPAEDIC CLUB

A meeting of the club was held at the Kent and Sussex Hospital, Tunbridge Wells, on March 15, 1952.

Clinical cases—*Mr W. H. Gerrts* showed the following cases. 1) Fixation of transcervical fractures of the neck of femur by four screws. 2) The use of compression in arthrodesis of certain foot joints and in the treatment of fractures with delayed union. 3) Arthrodesis of the spine by tibial grafts fixed with Barr's bolts. 4) A series of congenital abnormalities. 5) Cases of painful heel. *Mr E. W. Bintcliffe* showed a variety of cases including examples of quadriceps-plasty, arthrodesis of the ankle joint, bipartite lower tibial epiphysis, and polyarthritis of unknown etiology.

A further meeting was held at the Royal Sussex County Hospital, Brighton, on June 7, 1952. Clinical cases were shown and afterwards discussed.

Limb shortening—*Mr R. Brooke* showed two patients who had had limb shortening operations for discrepancy in limb length, due in one case to poliomyelitis and in the other to destruction of the lower femoral epiphysial plate. Both patients had been operated upon in adolescence fifteen years ago. The results were satisfactory, limb lengths being almost equal in both cases. Mr Brooke described in detail the method employed to assess the length of bone that should be removed in a growing child, and he pointed out that this depended not only upon the age of the patient and the difference of leg lengths at the time of operation, but also upon the nature of the disease affecting the shortened limb.

Abnormally short great toe—*Mr R. Brooke* showed an adolescent girl in whom a valgus ankle and rotated foot were attributed to a short hallux. The first metatarsal had been lengthened by traction after oblique osteotomy, with relief of her symptoms.

Arthrodesis of ankle—*Mr J. M. Turner* showed successful examples of arthrodesis of the ankle through the lateral approach, using the split fibula as a lateral onlay graft (Journal of Bone and Joint Surgery, 1948, **30–B,** 506). In his experience this simple method had been effective and he preferred it to other methods. In *discussion*, Mr St J. Buxton said that he had seen occasional failures from this method as from others. He thought that the ankle was one of the joints in which the problem of securing arthrodesis with certainty had not yet been solved.

Fracture-dislocation of elbow with separation of radial head—*Mr J. C. F. Lloyd Williamson* showed a child in whom a posterior dislocation of the elbow was associated with complete separation of the radial head. Satisfactory function had been restored after operative replacement of the radial head. Mr Williamson recalled that four cases of complete separation of the radial head had been reported by Jeffery (Journal of Bone and Joint Surgery, 1950, **32–B,** 314) among eighty cases of fracture of the radial head in children.

Concentric cup arthroplasty—*Mr J. Crawford Adams* showed five cases of "concentric" cup arthroplasty of the hip. A specially designed plastic cup had been employed which ensured accurate

concentric articulation of the femoral head within the cup, and of the cup within the acetabulum, to produce a mechanically sound arthroplasty. An unusually good range of stable movement was achieved and the patients all reported complete freedom from pain. After-treatment had been much shorter than that required for the orthodox Smith-Petersen mould arthroplasty. The results gained so far justified a continued trial of the method.

V arthrodesis of hip—*Mr Adams* showed four cases of arthrodesis by the method originated by H. A. Brittain and R. C. Howard and described by Howard before the British Orthopaedic Association in 1950 (Journal of Bone and Joint Surgery, 1950, **32–B,** 282). The hip is immobilised by a long arthrodesis nail and an ischio-femoral graft is inserted through a half-inch drill hole in the femur, which is not divided. In the cases shown, the only external fixation had been a short plaster spica for four weeks; knee movements had been practised from the beginning, and weight-bearing had been allowed at four weeks. The fusion was consolidating in all, but in one patient the femur had broken at the drill hole three months after operation.

Infantile cortical hyperostosis—*Mr W. Laurence* showed an infant with cortical hyperostosis affecting many of the long bones as well as the pelvis and mandible. There was pronounced visible swelling of the lower jaw, with marked tenderness over affected bones, reluctance to use the limbs, and moderate pyrexia. Mr Laurence recalled the essential features of this condition, of which only a few cases had been described (Fairbank 1951, Atlas of General Affections of the Skeleton. E. & S. Livingstone Ltd.). Differential diagnosis was mainly from osteomyelitis, scurvy, syphilis and hypervitaminosis A.

Other cases—*Mr Brooke* showed a case of Panner's disease which, though it resembled the ordinary osteochondritis of the second metatarsal head, he believed to be distinct; he thought that it was possibly caused by infection. *Mr Turner* showed a good result from fracture-dislocation of the ankle with tibio-fibular diastasis and gross upward displacement of the talus. He showed also a swelling of the thigh which proved to be a gumma, and reminded the company of the wisdom of considering syphilis in every differential diagnosis. *Mr Lloyd Williamson* showed a calcifying lipoma of the thigh and a case of excision of the proximal row of carpal bones for ununited fracture of the scaphoid with good result. *Mr Adams* showed an example of osteotomy of the spine for correction of severe flexion deformity and demonstrated his apparatus for angulating the spine after osteotomy. *Mr Laurence* showed three patients in whom a fractured medial epicondyle, included within the elbow joint, had been withdrawn by applying strong faradic stimulation to the forearm flexor muscles.

SOUTH-WEST ORTHOPAEDIC CLUB

A meeting of the South-West Orthopaedic Club was held at Musgrove Park Hospital, Taunton, on May 24, 1952, under the chairmanship of Mr R. F. Winckworth.

Avascular necrosis of the femoral head—*Mr K. Pridie* showed serial sections of the heads of femora excised for avascular necrosis complicating fracture of the neck of the femur. He emphasised the importance of the blood supply to the head of the femur, especially that of the ligamentum teres and its anastomosis with the branches of the circumflex vessels. He said that when non-union and avascular necrosis of the femoral head occurred after the old-fashioned method of treating fractures of the neck of the femur by doing nothing except to encourage active exercises of the hip, the head of the femur never disintegrated, but became revascularised. He believed that weight-bearing was responsible for the fragmentation which occurred with avascular necrosis after nailing. *Mr J. Bastow* thought this evidence showed how unwise it was to allow early weight-bearing after nailing. He believed that six months, or even more, should be allowed for union to occur, before the patient was permitted to take weight. Radiographs were of little value in determining whether or not union was present.

Arthrography of the hip—*Mr A. L. Eyre-Brook* showed arthrograms of patients with congenital dislocation of the hip. He thought that little could be gained from arthrography before reduction, but there was much to learn from it in the post-fixation period. It outlined the limbus clearly and gave assistance in determining whether a shelf operation was necessary. It also helped by showing up the interior of the joint and it might disclose an obstruction in the acetabulum. In some cases there appeared in the plain films to be recurrent subluxation of the head of the femur whereas arthrograms showed that reduction was, in fact, maintained. Arthrography in a case of old Perthes' disease had shown that the joint surfaces were congruous although deformed. He also showed a case of subluxation of the hip after poliomyelitis. Although it was said that such displacements were caused by rotation, in this instance rotation one way or the other did not

appear to make any difference in the arthrogram. Rotation osteotomy in this case had not led to improvement. *Mr F. C. Durbin* said that arthrograms should always be done early to distinguish between the true congenital dislocation and the primary subluxation of Leveuf. This might have an important bearing on prognosis. When the ossific centre of the femoral head was eccentric, an appearance of subluxation could be present which was shown to be false by an arthrogram.

Traumatic myositis ossificans—*Dr M. McAlley* had treated 100 cases of traumatic myositis ossificans with deep x-ray therapy. Activity of the involved muscles was allowed during the six weeks' course of treatment. Pain had disappeared in three weeks and did not recur; the new bone formation became less in extent, but did not always vanish.

Paralytic dislocation of the hip—*Mr Blundell Jones* discussed eight cases of paralytic dislocation of the hip in infants with cerebral palsy or poliomyelitis. He considered that valgus deformity of the femoral neck was a primary factor and that it could cause dislocation even without adduction. Valgus of the neck was attributed to lack of moulding from muscle action and weight-bearing during growth, so that the neck continued to grow in line with the shaft. It was most marked in patients paralysed during the first two years of life. Osteotomy at the base of the neck might restore stability if undertaken as soon as subluxation was recognised. In later cases stabilisation by construction of a shelf was necessary. Anteversion had not been a factor in his cases. *Mr Keith Lucas* had followed up thirty cases of pathological dislocation of the hips, some treated by Sir Robert Jones. In almost every case the dislocation had recurred after operative reduction. In no case had osteotomy, to correct the valgus deformity, been done. This might be the solution to a difficult problem.

Fracture of the neck of the femur—*Mr F. C. Durbin* illustrated nine cases of subcapital fracture of the neck of the femur immobilised with Austin Moore pins in the belief that the large bulk of the Smith-Petersen nail might increase the incidence of avascular necrosis by damaging further the blood supply of the head, as had been suggested. There was evidence of avascular necrosis in six cases and it was complete in three. In all except two cases the fracture-shaft angle was less than 30 degrees. The results were not sufficiently encouraging to justify a continuation of the method. He believed, however, that there was a place for the use of multiple pins in the fixation of slipped upper femoral epiphysis.

Infections of the hand—*Mr R. H. C. Robins* illustrated the treatment of subcutaneous infections of the hand complicated by skin necrosis. He emphasised the importance of operating in a bloodless field and of draining the abscess through the area of devitalised skin. A granulating area remaining after the infection had been controlled should be covered with a skin graft.

Clinical cases shown by *Mr A. E. Jowett* and *Mr R. E. Winkworth* included several of bone cavities closed by muscle flaps and chip bone grafts, and a case of tuberculosis of the patella.

EAST ANGLIAN ORTHOPAEDIC CLUB

A meeting of the East Anglian Orthopaedic Club was held at the R.A.F. Hospital, Ely, on March 29, 1952. Clinical cases were shown.

Electromyography—*S/Ldr Wynn Parry* demonstrated the value of electromyography in peripheral nerve injury and in the prognosis of anterior poliomyelitis. He showed how the apparatus could give information of return of muscular activity before clinical evidence was apparent. He demonstrated the different responses in degenerate muscle, regenerating muscle and normal muscle.

Putti-Platt operation for recurrent dislocation of shoulder—*Ft/Lt McRae* showed four cases of recurrent dislocation of shoulder treated by the Putti-Platt operation. After operation the arm was immobilised at the side for three weeks. Thereafter a sling was worn for three weeks, elbow movements and gentle abduction being encouraged. Finally the patients were transferred to a residential rehabilitation centre for full mobilising exercises. The patients shown all had a full range of abduction.

Intramedullary nailing—*W/Cdr Keir* discussed the use of intramedullary nailing. He thought it suitable for many fractures of the shaft of the femur, in cases of fracture of femur with other fractures in the leg, in some cases of delayed union and in some cases of malunion. He mentioned some complications, such as the development of myositis ossificans, bending of the nail, and missing the lower fragment when inserting the nail. This led to an interesting discussion of complications that other members had experienced.

Osteoclastoma of radius—*Mr Thomas* showed a case of osteoclastoma of the radius which recurred after local removal, and recurred again after x-ray therapy. The lower half of the radius

was then removed and replaced by a fibular graft. Recurrence again took place in soft parts and eventually involved the graft, which was therefore removed and the carpus fused to the ulna.

Miscellaneous cases—*Ft/Lt Oyston* showed the following among other cases: Macrocystic fibrous dysplasia; erosion of sacro-iliac region of ilium by plasma-celled myeloma; diaphysial aclasia; and osteochondritis of ischium.

MANCHESTER HOSPITAL REGION CLINICAL MEETING WITH LIVERPOOL ORTHOPAEDIC ASSOCIATION

The twelfth Regional Orthopaedic Conference was held on April 25, 1952, at Wrightington Hospital, Wigan. This meeting was combined with that of the Liverpool Orthopaedic Association.

Ischio-femoral arthrodesis for tuberculous arthritis in children—*Dr John Dobson* (Wrightington) said that with early diagnosis and streptomycin he hoped for a freely movable joint. If, however, there was bony destruction a sound bony ankylosis was the best outcome. In the past this had been difficult to achieve in children. After ilio-femoral arthrodesis only 52 per cent had fused. With the introduction of Brittain's method, the proportion of successful results had been much higher. He now reported twenty-four children aged between five and fifteen years. The Foley approach had been used in seventeen cases, and the Brittain approach in seven. The factors which he thought were important were as follows. 1) A tibial graft should be massive and should be inserted into good ischial bone. 2) It should be made to penetrate the bone deeply. 3) The femoral shaft should be displaced well medially. 4) The leg should be put in 45 degrees abduction for two weeks, and then brought down to the neutral position. 5) Plaster fixation should be continued for an average of seven months, weight-bearing being allowed during the last three months of this time. There had been no post-operative deaths and no complications. Of the twenty-four cases, fusion was successful in twenty and failed in four. Intra-articular fusion had occurred in 50 per cent. The failures were due to absorption of the graft at its medial end, and he thought that all resulted from grafts of insufficient length or bulk which did not penetrate far enough into the ischium.

Hand surgery in America—*Mr Harold Bolton* (Manchester) gave an account of his experiences of hand surgery in America. He had worked with Professor Sumner L. Koch in Chicago and gave a review of Professor Koch's practice and results in dealing with all manner of hand problems. The methods of tendon suture and tendon graft were fully described and illustrated. Samples of the suture material and instruments were shown.

Paraplegia in Pott's disease—*Mr D. Ll. Griffiths* (Manchester) reviewed the problem of paraplegia in Pott's disease. The depressing results of laminectomy or costo-transversectomy and the poor quality of recovery by conservative treatment had influenced him to try the operation of antero-lateral decompression in the severe cases. All were complicated by tuberculous foci elsewhere and the decision to operate had been taken when the paralysis had increased or remained stationary despite adequate fixation, or when fixation was impossible because of severe flexor spasms. Eight of the twelve patients operated upon made a rapid and complete neurological recovery; two failed to improve, and two patients died after the operation. *Mr Robert Roaf* (Liverpool) described his experiences with the same problem. He had done ten decompressions. Seven patients had made a neurological recovery; one had not improved; one had relapsed, and there had been one post-operative death.

In the ensuing discussion, *Mr John Charnley* and *Dr John Dobson* gave their experiences of this operation at Wrightington Hospital. Thirteen patients had been operated on; five made excellent recoveries but none so rapid as those in Mr Griffiths's series. There had been six post-operative deaths. It was generally agreed that the exact cause of the paraplegia could not be ascertained, but all operators had been struck by the constant presence of either inspissated caseous material, sequestrated disc material, or even a sequestrum as the cause of local pressure which they were sure was the most important feature. The most difficult cases were those of patients with late paraplegia who, at operation, showed no gross evidence of activity and had a sharp bony ridge as the cause of pressure. It was stated by *Mr Roaf* that he personally, on finding this, would leave well alone. It was agreed by all the speakers that antero-lateral decompression was an operation of magnitude suitable only for the orthopaedic surgeon of experience, and should be performed only in an institution where conservative treatment of Pott's disease could be carried out under ideal circumstances.

Madelung's deformity—*Mr F. C. Dwyer* (Liverpool) presented six cases of Madelung's deformity which he believed were due to traumatic damage and subsequent epiphysial arrest. Treatment

had been by shortening the ulna. *Mr F. Flatow* (Manchester) showed one case of excision of the lower end of the ulna with a pleasing result. *Professor B. L. McFarland* said that the choice between the two operations depended on whether the lower end of the radius was deformed and the articular surface oblique, in which case ulnar shortening should be done; if the articular surface was transverse either operation could give a satisfactory result.

Compression arthrodesis of the knee—*Dr H. B. Andrews* (Wrightington) presented ten cases of compression arthrodesis of the knee in children. Excision of the joint had been followed by four weeks' compression, and then a period of three months in plaster. Bony ankylosis had been secured in all, without apparent interference with growth. *Professor McFarland* said that he was not convinced that growth had been unaffected, but both he and *Dr Dobson* pointed out that whatever the drawbacks to the operation at least in all these cases the disease had been finally and completely eradicated which was in itself a very desirable feature. *Mr N. J. Blockey* (Manchester) showed radiographs of compression arthrodesis in a boy of thirteen which had been successful, but subsequently a deformity had developed at the lower femoral epiphysial line, and it was agreed that this constituted a potential danger. It was agreed that after the operation, protection by caliper was probably desirable until the epiphyses fused.

GLASGOW AND WESTERN DISTRICT ORTHOPAEDIC ASSOCIATION

A meeting of the Glasgow and Western District Orthopaedic Association was held on February 16, 1952.

Judet arthroplasty of the hip—*Mr Roland Barnes* (Glasgow) reported his experience so far with the Judet arthroplasty, chiefly for osteoarthritis and ununited fracture of the neck of the femur. Although the short-term results were superior to those of mould arthroplasty careful selection of patients for operation was still necessary. Elderly patients who had been confined to bed for many months had not been helped materially. Another cause of unsatisfactory results was incomplete correction of a flexion and adduction contracture, from inadequate excision of the anterior and inferior parts of the capsule and failure to tenotomise the adductors and ilio-psoas when required. If the capsule was thickened it should be excised; there was little to be gained by preserving it, except that stability was improved if it was sutured at the end of the operation. Osteophytes were removed from the rim of the acetabulum but the fossa was not deepened unless it was too shallow to retain the head of the prosthesis. It was important to choose a head of the right size, namely one that was a fairly tight fit but did not "squeak" on movement. After operation, the hips were usually held in abduction and neutral rotation by below-knee plasters joined by a broomstick for a period of three weeks. Older patients often walked better if they had little or no movement in the abduction-adduction range, provided there was no fixed contracture, for a gluteus medius limp was then avoided. In these patients he now concentrated only on flexion and extension exercises.

Nerve injuries complicating dislocation of the shoulder—*Mr J. Tulloch Brown* reviewed seventy-six cases seen at the Western Infirmary in six years, and his figures indicated that some form of nerve lesion occurred in about 25 per cent of dislocations. Clinical evidence suggested that most were stretch lesions produced at the time of dislocation and in many the symptoms were transient, and revealed only by careful neurological investigation. No definite relation to type of injury, method of reduction, or delay in reduction, could be established. The patients studied included six with transient circumflex sensory loss; fifty-three with complete motor circumflex paralysis (mostly with full recovery), and seventeen with multiple lesions or isolated lesions other than those of the circumflex nerve. *Discussion* followed. It was considered that perhaps the method of reduction was not an unimportant factor in the causation of these lesions. It was often difficult to examine a patient with an acute dislocation to ascertain if the lesion was present after reduction. It was agreed that to clarify this point patients with dislocated shoulders should have a more careful neurological examination before reduction.

EAST AFRICA

ASSOCIATION OF SURGEONS OF EAST AFRICA

The Association now numbers fifty-one Fellows, two Associate Fellows and two Honorary Fellows. Affiliation has been arranged with the Association of Surgeons of Great Britain and Ireland. It is proposed to hold quarterly meetings in Nairobi and in other East African centres. The first conference of 1952 was held in Nairobi under the presidency of Mr C. V. Braimbridge. The following were among the subjects discussed.

The intervertebral disc—*Mr A. M. Wood* described briefly the pathology and symptomatology of disc lesions and demonstrated one case. He described the various forms of treatment and gave the details of the operative technique. He emphasised that operation should be done only when conservative treatment had failed. He did not advocate spinal fusion at the time of exploration of the disc. *Mr D. Burkitt* said that back pain was common amongst Uganda Africans, but sciatica was rare. *Mr W. H. Kirkaldy-Willis* said that he always fused the spine after exploring the disc and that he believed that many cases of severe chronic backache were due to lumbo-sacral strain, and not to disc prolapse. *Mr A. C. Fisher* said that several cases in which he had found no prolapse and which he had not grafted were amongst his most successful cases. He believed that decompression of a disc that underwent recurrent dislocation was responsible for this. *Mr G. V. W. Anderson* said that in his experience the keyhole approach was inadequate and that it would be necessary to wait for many years before it was possible to assess the final results of exploration of the disc. He believed it was essential to explore both the L.4–5 and L.5–S.1 spaces.

Plastic surgery—On Friday, February 1, *Sir Archibald McIndoe* gave a stimulating lecture on the " Surgery of Repair." He said that it took four years to train a plastic surgeon. He outlined the various techniques employed in skin grafting and plastic repair in such a way that all those present were able to understand, if not the niceties, at any rate the general principles underlying this branch of surgery. Later, Sir Archibald took the chair at a clinical demonstration of cases needing plastic surgery in one of the wards of King George VI Hospital. Thanks are due to him for a most enjoyable and invigorating morning.

HOLLAND

HALF-CENTURY COMMEMORATION OF THE NETHERLANDS SOCIETY OF SURGEONS

In the first days of April 1952 the Netherlands Society of Surgeons celebrated its fiftieth anniversary by a meeting in Amsterdam when after three days of clinical and operative sessions a conference was held in the great hall of the Colonial Buildings (Koninklijk Instituut voor de Tropen). Messages of congratulation were conveyed from the various groups of specialist surgeons including one from Dr W. C. Meiss, President of the Netherlands Orthopaedic Association. Sir Reginald Watson-Jones attended as president of the British Orthopaedic Association; he also conveyed greetings from the Royal College of Surgeons of England and gave an address on " Fifty Years of Orthopaedic Surgery." Dr Van Houweninge Graftduk outlined fifty years' history of the Netherlands Society of Surgery. Professor Boerema gave an address on " Experimental Research in Ligation of the Major Vessels." The ceremonies concluded on Sunday, April 6, with a series of papers from the surgeons of Haarlem, Leiden, Gronigen, Utrecht, Rotterdam, Arnhem, Zwolle and elsewhere in Holland.

DUTCH ORTHOPAEDIC ASSOCIATION

Tuberculosis of the ankle joint—At the June, 1951, meeting of the association *Dr van Haeff*, director of the sanatorium for bone and joint tuberculosis at Wijk aan Zee, showed some results of operative treatments of tuberculosis of the ankle joint. He thought that in many cases early operation, consisting of transfixion of the joint with a strong cortical graft from the opposite tibia, was indicated. Through a small medial incision a graft half an inch wide was driven transversely through the medial malleolus, talus and lateral malleolus. The presence of the graft promoted the healing of the tuberculous process and immobilised the joint in the desired position. If any abscess formation and secondary infection occurred, it could be kept under control by antibiotics. The operation had been carried out on twenty-three patients from ten to forty-five years old. Of these, two died (of renal and pulmonary tuberculosis respectively). In twenty patients the ankle healed completely. Observation periods ranged from three to eighteen years.

Congenital defect of the femur—At the meeting held in November 1951 *Dr J. H. ten Kate* of Rotterdam demonstrated an abnormal arteriogram in a case of congenital femoral defect at the age of nine months and drew attention to the importance of the arterial supply of the leg in this condition.

Officers of the Dutch Orthopaedic Association for the year 1952 are: Dr W. C. Meiss, president; D. Willebrand, vice-president; J. G. A. Kerssemakers, secretary, Kennemerstraatweg A 9 Alkmaar.

OTHER EVENTS OF ORTHOPAEDIC INTEREST

Calf bone bank—A calf bone bank has been organised by the Dutch Red Cross at the initiative of Mr W. C. Meiss of the Hague, whose work on this subject has already been mentioned (Journal of Bone and Joint Surgery, 1951, **33-B**, 466). Calf bone is removed under aseptic conditions from fresh cadavers at the slaughterhouse and frozen. Strict bacteriological control is exercised. The bone is kept ready for distribution in glass jars and delivered to surgeons throughout the country at low cost. The Red Cross had already organised a bank for blood and human milk for the entire country. Owing to its previous experience and the available organisation setting up of the bone bank was comparatively easy.

The Anna Kliniek, Leiden—Dr J. D. Mulder has taken up his appointment as director of the Anna Clinic in succession to Dr van Nes.

DENMARK

DANISH ORTHOPAEDIC ASSOCIATION

A meeting of the Danish Orthopaedic Association was held in Copenhagen on April 19 and 20, 1952.

Investigations of the venous system of the lower extremities during activity—*K. Dohn* (Copenhagen) gave an account of blood-volume measurements in the lower extremities in relation to change in posture by tilting and during walking. A special plethysmograph has been constructed by the author in collaboration with *N. Jarlov* and *J. S. Gravenhorst*. The apparatus permits segmental plethysmography on the lower leg and on the foot during activity and measurements of changes in volume in absolute figures per 100 millilitres of the extremity. The method is applicable to routine clinical work. The knowledge acquired by this " functional plethysmography " of the venous circulation during change in posture has been applied to the method of phlebography. By the author's method of phlebography it is possible to determine whether the valves of the deep veins are competent or not. *Technique*—The injection is performed in a vein on the foot with the patient in the horizontal position. Immediately afterwards the table is tilted to the standing position in the course of two to three seconds. Upper and lower leg are simultaneously radiographed between two to twenty seconds after the tilting according to the severity of the venous obstruction. Segmentation of the contrast medium is observed if the venous valves are competent. A simple apparatus for measuring the venous pressure during function was demonstrated.

The value of these different functional tests was shown in diagrams and radiographs. Function of the deep veins before and after resection of the saphenous vein was demonstrated. Deep venous incompetence of non-thrombotic origin was also demonstrated, the incompetence being primary in some patients and secondary to dilatation in others, who had had varicose veins for many years. Finally diagrams were shown demonstrating the effect of deep vein resection and of bandaging of a post-thrombotic leg.

Experience with surgical treatment of the post-thrombotic disease—*A. Bertelsen* and *K. Jansen* (Copenhagen) reported twenty-four popliteal and five femoral resections in patients with post-thrombotic legs. The clinical results were compared with the results of pre- and post-operative functional testings performed by *Dr Dohn* according to the methods he had described in the previous paper. The following provisional conclusions as to the pathological classification of cases were drawn. One-fifth had sequels of partial thrombosis of the lower leg. Scarcely one-half had deep venous incompetence following complete recanalisation of the thrombosed veins with no evidence of venous obstruction. The remaining one-third revealed an obstruction to the venous return evidenced phlebographically by a spongy structure of the femoral vein and plethysmographically by a prolonged emptying after tilting from the upright to the horizontal position, a small retrograde bloodflow and an increase in some cases of the leg volume and venous pressure during walking. Provisional conclusions as to treatment were as follows. In cases with complete recanalisation of the femoral vein deep resection is of no benefit, the reflux being decreased at the cost of a venous obstruction. In cases of incomplete recanalisation with signs of deep venous obstruction resection of the obstructed vein is indicated as all the improved cases belonged to this group. Neither lumbar sympathectomy nor perivascular sympathectomy seems to have any effect in improving the venous circulation. In cases with sequels of partial deep thrombosis of the lower leg operation on the superficial varicosities is of value. A Hohmans operation and a complete

excision of the diseased skin and subcutaneous tisse of the lower leg followed by grafting have been tried in two cases with promising results.

Operations for hallux valgus—*H. Mygind* (Copenhagen) reported 535 cases of hallux valgus operated on by different methods. A theory of the etiology and the mechanism was put forward. Simple excision of the exostosis gave recurrences of symptoms and an arthroplastic procedure after the manner of Mayo-Bentzon gave excessive shortening of the first metatarsal bone and no function of the toe during gait. The best results were obtained by an oblique osteotomy of the first metatarsal close to the head, the head being displaced laterally and plantarwards on the shaft and kept in place with a peg-and-hole method devised by Thomasen. Thereby the valgus subluxation of the joint and lateral luxation of the sesamoids were avoided, the power of the short flexor was restored and weight-bearing on the first metatarsal head was re-established. One hundred patients had been operated on by this method. Only one pseudarthrosis developed. In the remaining cases the plaster shoe was removed and weight-bearing resumed after five weeks.

Minor amputations in the foot in the presence of peripheral vascular disease—*J. Foged* and *K. H. Køster* (Copenhagen) assessed nineteen cases operated upon. The primary results were good in twelve, not satisfactory in two and bad in five. In seven cases followed up for one to four years five were still good and two developed further gangrene. In discussion, *Drs Kiaer* (Copenhagen) and *Thomasen* (Aarhus) agreed that "atypical" amputations in the foot had a definite field in cases of arteriosclerotic and diabetic gangrene.

Officers—Dr E. Thomasen, of Aarhus, has been elected president of the Association in succession to Dr S. Kiaer. Dr K. Jansen, of Copenhagen, has been appointed treasurer.

SWEDEN

DR HENNING WALDENSTRÖM

It is hard to realise that Henning Waldenström, one of the most vigorous personalities at the International Congress in 1951, will be seventy-five years of age this coming August. Born of a family with its roots deep in Swedish academic tradition—both father and grandfather were physicians, the former Sweden's first professor of surgery—Waldenström received a sound training for his profession. His first position of authority was as chief of the department of bone and joint tuberculosis at the St Goran Hospital in Stockholm where he remained for twenty-five years.

Dr Henning Waldenström.

At the age of fifty-eight, Waldenström was appointed to the chair of orthopaedics at the Caroline Medico-Surgical Institute, then the only professorship in this discipline in Scandinavia. During the brief six and a half years before his retirement, he was able to revolutionise many aspects of Swedish orthopaedic surgery. Much of what is being written on the subject in Sweden to-day has been stimulated by impulses from the Waldenström era. Waldenström's own scientific writings, though inconsiderable in volume, are models of clear thinking and precision. This reflects a certain selective quality that is typical of the man's whole attitude to life.

In these hectic times, when so many of us take on more responsibilities than we can successfully discharge, an encounter with Henning Waldenström is always a refreshing experience. For he has the wisdom and the strength of character to reject much that might be tempting and to select only the friends and assignments to which he knows he can do justice.

Those who have had the privilege of working with Waldenström look up to him with respect and affection for his critical though generous mentality, his youthful vigour and his spiritual maturity.

GREECE

JOURNAL OF ASCLEPIION OF VOULA

We welcome the continued success of the Journal of Asclepiion of Voula which was first published last year from the Hospital " Asclepiion of Voula " in Athens under the direction of an editorial committee with Professor Th. Garofalides and Dr G. Michalatos. The second volume, published this year, includes important contributions on congenital tibial kyphosis by Professor Garofalides himself; intramedullary nailing in pseudarthrosis and delayed union of fractures of long bones by Alex. Hadzigeorges and Chrys. Chrysanthakis; intramedullary wiring of fractures of the clavicle by Professor Th. Garofalides and Dr G. Michalatos; osteochondromatosis of the knee treated by synovectomy by Drs Hadzigeorges and Chrysanthakis; the pathology and treatment of hallux valgus by Professor Garofalides and Dr Michalatos; and the therapeutic uses of intravenous, intra-arterial and rectal injection of novocain in orthopaedic surgery by Dr Ch. Athanassiadis.

CZECHOSLOVAKIA

PROFESSOR JAN ZAHRADNICEK

In June 1952 Professor Jan Zahradnicek, a pioneer of orthopaedic surgery in Czechoslovakia, attained his seventieth birthday. Born in 1882, he studied orthopaedic surgery with Professor Tobiasek in Prague. In 1921 he was appointed orthopaedic surgeon to the Medical School of Masaryk University. He returned to Prague six years later and in 1931 he succeeded Professor Tobiasek as chief of the clinic for orthopaedic and paediatric surgery of Charles University, where he is still working. Among varied activities in the field of surgery and orthopaedics, he founded the Czechoslovak Society for Orthopaedic Surgery and Traumatology and is the delegate of the Society for Czechoslovakia.

ITALY

ITALIAN SOCIETY OF ORTHOPAEDIC SURGERY AND TRAUMATOLOGY

The thirty-seventh Congress of the Italian Society of Orthopaedic Surgery and Traumatology will be held at Genova in the Simon Boccanegra Castle, from October 6–8, 1952, under the presidency of Professor Raffaele Zanoli. The main subject for discussion will be the paralytic shoulder, opened by Dr F. Roasenda and Dr A. Strata. A discussion on periarthritis of the shoulder will be opened by Professor A. Bonola, of the University of Modena.

URUGUAY

URUGUAY SOCIETY OF ORTHOPAEDIC AND TRAUMATIC SURGERY

The president of the society for 1952 is Dr Domingo Vasquez Rolfi. Dr Ricardo Caritat is vice-president and Dr Hebert Cognoli secretary.

CORRESPONDENCE

TRAUMATIC ANTERIOR DISLOCATION OF THE HIP

From Mr St J. D. Buxton, London, England

To the Editor of the Journal of Bone and Joint Surgery.

Sir,

In many numbers of the Journal you publish brief reports of rare and interesting conditions. This practice is to be commended because it draws attention to such rarities and leads to scientific thought and discussion. The report by R. S. Henderson (Journal of Bone and Joint Surgery, **33–B,** 602, 1951) is noteworthy for several reasons and I venture to make comment and amplify his contribution in the hope that assistance may be given to those confronted with a traumatic anterior dislocation of the hip. It is not that my experience exceeds his own, for I can remember only one such case, which was reported for me by E. J. Smith (Proceedings of the Royal Society of Medicine, **27,** 579, 1933-34); but the literature is so interesting that it is hoped that your readers will spare some hours in referring to the writings of Astley Cooper (A Treatise on dislocations and fractures of the Joints, 1842, a new edition edited by Bransby B. Cooper. London: John Churchill) whose experience of hip dislocations should be the envy of any surgeon.

Mr Henderson does not seem to know of Astley Cooper's reports in the first half of the last century; for instance, in his article it is stated that forward dislocation is very unusual. In 1842 it was recorded that in twenty cases the relative proportion was: twelve on the dorsum ilii; five in the ischiathic notch; two in the foramen ovale; and one on the pubes. Although three cases of unreduced anterior dislocation were reported there was no mention of failure of reduction within twenty-four hours—which concurs with Henderson's observation. He is surprised to find no record of this lesion being produced by such a simple mechanism as that of his unfortunate football player; but it is interesting to read: "*Cause*—It happens when a person while walking puts his foot into some unexpected hollow in the ground; and his body at the moment being bent backwards, the head of the bone is thrown forwards upon the os pubis. A gentleman who had met with this dislocation in his own person, informed me that it happened while he was walking across a paved yard in the dark; he did not know that one of the stones had been taken up, and his foot suddenly sank into the hollow, and he fell backwards. When his limb was examined, the head of the thigh bone was found upon the os pubis." The woodcut depicting the deformity shows the right lower limb in lateral rotation and slight abduction as reported by your author.

It would have been of interest to some readers, and of great value to many surgeons in training, if there had been a description of the "attempts to reduce the dislocation by manipulation." Astley Cooper's description of the manipulation is worthy of study, even if no orthopaedic surgeon to-day uses the perineal girth and the thigh pulley.

Yours very truly,

March 24, 1952. St J. D. BUXTON.

TROCHANTERIC FRACTURES OF THE FEMUR

Mr Mervyn Evans writes in reply to a letter of Mr J. C. Scott's published in the May issue of the Journal pointing out that Mr Scott has confused his two series of cases. Only in the first series treated before 1948 and reported in the Journal (Vol. **31–B,** 190, 1949) was there selection of cases accounting for the low average age and low mortality. Patients with trochanteric fractures of the femur treated since 1948, and reported in Mr Evans' second article (Vol. **33–B,** 192, 1951), were not selected. No patient with a trochanteric fracture of the femur brought to the door of the hospital was turned away, and every one was operated on, the old and the feeble as well as the young. This was in fact a consecutive and entirely unselected series.

Book Reviews

AN ATLAS OF GENERAL AFFECTIONS OF THE SKELETON. By Sir Thomas FAIRBANK, D.S.O., O.B.E., M.S., Hon.M.Ch.(Orth.), F.R.C.S. Consulting Orthopaedic Surgeon and Emeritus Lecturer in Orthopaedic Surgery, King's College Hospital; Consulting Surgeon, Hospital for Sick Children, Great Ormond Street; Emeritus Consulting Surgeon, Treloar Orthopaedic Hospital, Alton; Honorary Consultant (Orthopaedic) to the Army. $10\frac{1}{4} \times 7$ in. Pp. xx+411, with 510 figures. Author Index. General Index. 1951. Edinburgh and London: E. & S. Livingstone Ltd. Price 55s.

Sir Thomas Fairbank knows far more about bone disease than anyone else in this country. This is not only because of his many years on the staff of an undergraduate teaching hospital and of the Hospital for Sick Children, Great Ormond Street, but also because he is our orthopaedic father, whose interests we know and to whom we all take our problems and prizes. For our part, we have received invariable kindness and wisdom; and for his part, Sir Thomas has accumulated a vast store of experience.

The quality and method of the sixty-two chapters need no description, because several have already appeared in this Journal, and readers know well their scope, clinical flavour and wealth of personal observation. They are even better when brought together with their fellows, and when preceded by a gracious preface and by an introduction that includes a classification and some useful diagnostic tables and discussions.

Seeing that many illustrations have been chosen for their clinical interest rather than their technical competence, production is mainly excellent, so that we forgive uncut pages and the omission of rickets from the index. This is the valuable book that we all expected.—H. Jackson BURROWS.

POSTGRADUATE LECTURES ON ORTHOPEDIC DIAGNOSIS AND INDICATIONS. By Arthur STEINDLER, M.D., F.A.C.S. Professor of Orthopedic Surgery, State University of Iowa, Iowa City, Iowa. Volume II. Section A: Paralytic Disabilities. Section B: Static Disabilities. 10×7 in. Pp. xiv+198, with 140 figures. Index. 1951. Springfield, Illinois: Charles C. Thomas, Publisher. Oxford: Blackwell Scientific Publications. Price 45s.

In the Second Volume of his Postgraduate Lectures Professor Steindler deals with paralytic and static disabilities. The subject of poliomyelitis is presented in all its aspects and, as one would expect, contains a penetrating analysis of the mechanics of paralytic deformities. In the chapter on lumbo-sacralgia we note the emphasis on a conservative attitude in the choice of methods of treatment. The section on internal derangement of the knee joint follows conventional lines. In idiopathic scoliosis and static deformities of the foot, however, the writer's profound grasp of the biophysical factors concerned in the etiology of such deformities is once more an outstanding feature of his teaching.—Harry PLATT.

CHIRURGIE ET ORTHOPEDIE DU RHUMATISME. By J. J. HERBERT. $10 \times 6\frac{1}{2}$ in. Pp. 297, with 203 figures. 1950. Paris: Masson et Cie. Price 33s.

A presentation such as this, of the surgical aspects of rheumatism, is much needed in the English literature. Not only is the author modest upon what can be achieved; he is thorough and eclectic. Detailed accounts are given of plaster methods in the correction of deformities, and of surgical approaches for the same purpose as well as for all the recently developed procedures of joint reconstruction. Difficulties and dangers are discussed, and very fair assessments of the results to be expected are illustrated by adequate case summaries. Medical works upon rheumatism are often diffuse because the boundaries of the subject are so difficult to draw; in the present work the scope is crystal clear and therefore refreshing. Furthermore, the precision of French technical literature is well exemplified.

The attitude of the author is nicely expressed in his postscript. "What are the conclusions to be drawn on completing this work? There is none, for my essay is only a contribution to an endless structure. I have tried to make a synthesis of what the surgery of rheumatism should be. I present my own personal experience and selected work from the contemporary literature. Such a work is merely a snapshot of current practice. We must be cautious in discussing pathogenesis

and our present classification of these diseases is merely convenient: but is it the truth? About this one must maintain reserve; for ideas change. For the surgeon, however, there are eternal rules from which he must not deviate. First of all is the duty he shares with the architect—no detail can be neglected. One must think of everything; each problem must be studied; solutions carefully composed, so as to select the best. Oversight of a single detail or the completion of a plan insufficiently thought out may have fatal consequences. But you may say: Chance and fate may both intervene. Chance: Yes! In a certain measure it does preside over life's destinies. Yet it is always enclosed within certain limits as the laws of probability teach us. But fate: No! Beware of those surgeons who invoke fate to explain their failures. There are errors and faults which a loyal mind, capable of self criticism, will recognise."—Norman CAPENER.

MEDICAL DISORDERS OF THE LOCOMOTOR SYSTEM, INCLUDING THE RHEUMATIC DISEASES. By Ernest FLETCHER, M.A., M.D., M.R.C.P. Physician-in-charge of the Department of Rheumatism and Lecturer on the Rheumatic Diseases, Royal Free Hospital. Second edition. $9\frac{1}{2} \times 6$ in. Pp. xii + 884, with 377 figures. Index. 1951. Edinburgh: E. & S. Livingstone, Ltd. Price 60s.

Dr Fletcher writes from the point of view of the general physician interested in disorders of the locomotor system, particularly those of "rheumatic" context. That his book has come to a second edition is an indication that the work, originally published in 1946, has fulfilled a need. Now that it has been enriched by chapters from new contributors, such as Professor S. L. Baker, it gains added authority. Strangely, however, the orthopaedic aspects of locomotor disease are lacking in this respect. Perhaps the author has restricted himself to a purist interpretation of his title; and yet, what indeed are the "medical" disorders of locomotion? Here there is a vast assemblage of facts and syndromes. Upon any subject which might conceivably be termed "rheumatic" the author shows an encyclopaedic knowledge. The orthopaedic surgeon will, however, be disappointed if he hopes to get much help in the many and varied medical problems which he encounters in his daily work, except from those parts of this book which deal with the background and strictly rheumatological aspects of it. Let us consider tuberculosis of the skeleton, one of the great interests of orthopaedic surgeons, the treatment of which always has been to him mainly a medical problem. What can we learn from Dr Fletcher about it: even about the medical complications in the genito-urinary and central nervous systems, or about chemotherapy? Almost nothing. Even upon the basic problems of diagnosis and conservative treatment the work shows no evidence of practical contact, and it is fallacious. We do not wish to be hypercritical, but the sketchiness of discussion upon tuberculosis is found also in osteomyelitis (how often diagnosed as rheumatism), poliomyelitis, bone tumours and developmental anomalies. The truth is that this book is incorrectly titled; it should be "The Rheumatic Diseases including many other disorders of locomotion." Upon the former it is excellent. The articles upon background subject are of great value. These include the Physiology and Pathology of Bone (Professor S. L. Baker), Dental Infection (Dr G. T. Calthrop), Fibrositis (Dr W. S. C. Copeman), the Incidence and Prevalence of Rheumatism (Dr E. Lewis-Faning), Pain (Dr Anthony Fletcher), Laboratory Findings (Dr H. J. Gibson), Radiology (Dr F. Campbell-Golding), Medical Diseases of Bone (Dr Donald Hunter), Hydrotherapy (Dr G. D. Kersley), Applied Anatomy (Professor G. A. G. Mitchell), Psychiatry (Dr J. Barrie Murray), Synovial Mucin (Dr C. Rimington), Ear, Nose and Throat Infections (Mr W. G. Scott-Brown) and Electromyography (Dr A. G. M. Weddell). These articles comprise a little less than a third of the book. The discussion of the principles and methods of splintage though enthusiastic are sketchy.—Norman CAPENER.

TUBERCULOSIS OF BONES AND JOINTS. By D. Ll. GRIFFITHS, M.B.E., F.R.C.S. Reprinted from Modern Practice in Tuberculosis, edited by T. Holmes Sellors, M.A., D.M., M.Ch., F.R.C.S., and James L. Livingstone, M.D., F.R.C.P. 1952. London: Butterworth & Co. (Publishers) Ltd.

Bravery always merits admiration. Hats off therefore to this author who, in discussing modern practice in tuberculosis, illustrates the case of a man with disease of the spine who refused to undergo any treatment and got quite well. Griffiths is obviously dubious about the wisdom of modern conservative treatment. He records many of its drawbacks. And yet, so impressionable is the young medical postgraduate, he cannot quite bring himself to desert the doctrine ground into him during his youth of enforced, uninterrupted and prolonged rest. This small article stimulates thought.—George PERKINS.

ARTERIOSCLEROSIS AND ARTERIAL THROMBOSIS IN THE LOWER LIMB. A Roentgenological Study. By Ake LINDBOM, from the x-ray diagnostic Department of Karolinska Hospital, Stockholm. 10 × 7½ in. Pp. 80, with 42 figures. 1950. Stockholm: Acta Radiologica Supplementum LXXX. Esselte Aktiebolag. Paper cover. Price not quoted.

This monograph is intended to correlate the arteriographic picture with the pathological changes in the arteries of the lower extremity, and to this end the author has made a painstaking study of a large number of arteriograms made during life and at necropsy. He has devised a graphic method of recording the incidence of narrowing or obliteration of the arteries at different levels, and he has had the assistance of pathologists in the interpretation of the morbid anatomy. The technique of arteriography is described and attention is drawn to the advantages of retrograde puncture of the femoral artery. It is stated that intimal thickening and medial calcification show an inverse relationship to each other, and that thrombosis is much more common in the leg than in the thigh. The author lays stress upon the importance of intimal haemorrhage, which he believes to be the cause first of considerable thickening of the intima, and later of intimal calcification and arterial occlusion. The haemorrhage into the intima is said to be due to tearing of the sclerotic artery during movements of the limb, a supposition which is supported by the clinical history of many cases of arterial thrombosis.

Although there may not be much that is new in this work, it is valuable as a careful record of radiographic and pathological investigations of a large number of patients with arteriosclerosis.—J. Paterson Ross.

UBER DIE GROSSEN AMPUTATIONEN AN DEN EXTREMITATEN UND DIE PROTHETISCHE VERSORGUNG DER AMPUTIERTEN. By Fritz JENNY. 9½ × 6½ in. Pp. v + 166, with 82 figures. 1950. Berlin: Springer-Verlag. Paper cover. Price 31s. 6d.

The author works in Switzerland, where one would expect the amputation rate during the last forty years to be as low as in any European country. He has written on most aspects of amputation and limb fitting in a book of 166 pages.

The subject matter is classified into the types of amputation, after-treatment, complications and a large section on prostheses. The technique and details of operations are not described, but the advisable level of amputation is discussed and illustrated. As in other similar books there is more than mention of certain operations that most surgeons consider obsolete. The after-treatment is on lines used in this country. No new work is reported in the causation of painful stumps or painful phantom limbs. The central European work on the Krukenberg operation is briefly reported. Quite half the book is concerned with artificial limbs. This is very practical and up to date. The socket made from laminated wood blocks on a copying machine and the suction socket are described. Many artificial hands are described and illustrated; it is not known whether this is because of the popularity of such an appliance with fingers or because of the failure to produce a model of real use to most arm amputees, which is common experience. The fitting of tools and appliances to a forearm prosthesis is on usual lines.

There is no book written in English which contains the information on prostheses in so small a space, and it is for this the book will be read. The earlier part of the book is necessary to lead to this subject matter. The author is to be congratulated on the bibliography at the end of each section. This is up to date and the references are to books and articles from at least six countries.—St J. D. BUXTON.

INTRODUCTION TO CLINICAL NEUROLOGY. By Gordon HOLMES, M.D., F.R.S. Second edition. 9½ × 6 in. Pp. vii + 189, with 43 figures. Index. 1952. Edinburgh: E. & S. Livingstone Ltd. Price 12s. 6d.

Neurology and orthopaedic surgery overlap; who of us has not missed a diagnosis of disseminated sclerosis? This small book is only an introduction to neurology but it shows how a distinguished neurologist approaches his subject. It brings to light facts forgotten or unknown. Not everyone for instance knows the difference between rigidity and spasticity, or fibrillation and fasciculation. It is, perhaps, not a book to buy but it is certainly one to read. A profitable evening can be spent with it.—George PERKINS.

DIE GESUNDE UND KRANKE WIRBELSÄULE IN RÖNTGENBILD UND KLINIK. By Georg SCHMORL and Herbert JUNGHANNS. 11¼ × 8 in. Pp. 284, with 399 figures. No index. 1951. Stuttgart: Georg Thieme Verlag. Price DM. 69.

Schmorl died in 1932, the year which marked the publication of his classic work on the spine in health and disease. The mass of material presented in that book, founded on many thousands of personal observations and on the correlation of anatomical with radiographic appearances, made it the basis of our thinking on this subject and laid the foundation for a living pathology of the spine on which many have since built. Like other foundations, its existence was often unknown to later comers and the merits of the original were such that frequent revision was unnecessary. Now, after twenty years, Professor Junghanns, who was Schmorl's collaborator in

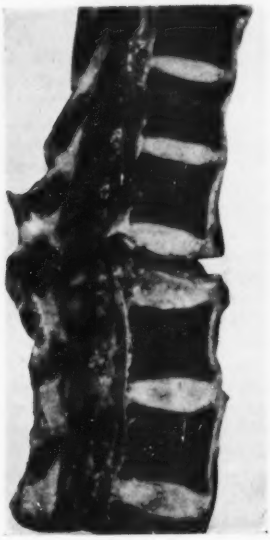

FIG. 187

FIG. 188

Figure 187—Photograph of the cut surface of a sagittal section of a lumbar vertebra. Complete collapse of body of tenth dorsal vertebra resulting from typhoid (spondylitis typhosa). Slight thickening of the adjacent intervertebral discs. Figure 188—Lateral radiograph of the same case.

the radiological side of the work, has produced an enlarged edition in which the text has been rearranged and new illustrations have been added to the originals, in the attempt to add a clinical and functional emphasis to the anatomico-pathological basis.

The attempt is not perhaps altogether successful. The book remains primarily attractive as a descriptive atlas, with its well-remembered and beautiful illustrations; but there is little said on the newer hormonal and experimental aspects of the subject, and where there is a discussion of clinical problems—as in the lengthy section on intervertebral disc prolapse—this leaves the impression of coming from an academic rather than a practising clinical source. Disappointingly little is said of ankylosing spondylitis and nothing is shown of the sacro-iliac joints in this disease. These are trivial criticisms, however, for the gross pathology of the common and uncommon disorders of the spine is thoroughly covered and the simultaneous presentation of photographs and x-rays of the same specimens is most instructive. The publishers are to be congratulated on the excellence of these reproductions.

The section on development is one of the best, with its account of the lumbo-sacral anomalies and a retained emphasis on the congenital basis for spondylolisthesis; the chapter on degeneration and disease of the intervertebral discs is also noteworthy. Any orthopaedic surgeon with even the slightest knowledge of German will find this book worthy of perusal. There is an enormous bibliography, with a predominance of German and other European sources.—David LE VAY.

THE LIFE AND WORK OF ASTLEY COOPER. By R. C. Brock, M.S., F.R.C.S., F.A.C.S. Surgeon to Guy's Hospital; formerly Astley Cooper Student, Guy's Hospital. 9 × 6¼ in. Pp. viii + 176, with 14 figures. Index. 1952. Edinburgh: E. & S. Livingstone Ltd. Price 20s.

This is a timely medical biography of a great man. Mr Brock, I think, shares my opinion that the pupil was greater than the master, John Hunter. He is certainly a warmer and richer character, and he played his part in front of the back-drop provided by the Napoleonic era. No biography has appeared since that of Bransby Cooper in 1843. Genius, character and period lay ready for fresh assessment.

It is as true as any generalisation can be to say that no medical man should be permitted to write a biography. The long habits of case taking have dulled his mind to the more artistic variations in biographical form, and he automatically follows the Caterpillar's instructions to Alice: "Begin at the beginning and go on to the end." In spite of its familiarity this method still appeals to doctors, and, as this biography is primarily a factual summary for medical men, it is as such that it should be judged. Like all good biographers Mr Brock identifies the interests of his subject with his own, and we have a refreshing emphasis on Astley Cooper as a potential specialist in vascular surgery. As Astley Cooper was one of the last of the line of Master General Surgeons he can be all things to all specialists, and the orthopaedic surgeon might well demand a more even treatment of his masterpiece on injury, which ran through more editions than any other monograph he wrote. Cooper's work on avascular necrosis of the femur has been largely forgotten though he put the matter as clearly as it can be put to-day.

Bettany has been rightly trounced here for his statement that "He (Cooper) cannot be classed among men of genius or even of truly scientific attainments; his works are not classic, but they are more than respectable. They are defective from their almost entire omission to refer to the works of others." And yet there is a grain of truth in these remarks, and had Astley Cooper given full credit to older authors the following sentence would not have appeared in this book. "It is possible that Sir Astley Cooper was not the first to use the 'heel in axilla' method for the reduction of a dislocated shoulder, but his description and illustration of it appear to be the first." It would simply have been described as the Hippocratic method.

The enigma of Cooper: his unquestioned professional leadership followed so soon by an almost complete loss of interest in him, and the conflicting estimates of his abilities by his contemporaries, are not resolved in this partisan volume, but it is an attractive and readable tribute to one to whom all orthopaedic surgeons remain deeply indebted, and who has set the whole profession a supreme example of single-mindedness.—J. G. Bonnin.

THE APOLOGIE AND TREATISE OF AMBROISE PARÉ, containing the Voyages made into Divers Places, with many of his writings upon Surgery. Edited, and with an introduction, by Geoffrey Keynes, M.D., F.R.C.S., F.R.C.O.G. 8½ × 5½ in. Pp. xxvi + 227, with 4 plates and 21 figures. Index. 1951. London: Falcon Educational Books. Price 15s.

Garrison, in his "History of Medicine," refers to three great men who lifted "the surgical art to its modern scientific status." Two of the three, Hunter and Lister, have been the subject of new biographies recently reviewed in this Journal. The third, who was the first in time and perhaps in significance, painted his own portrait, and for a racy, vivid and thoroughly delightful account of a great surgeon and of the attributes which go to his making, one cannot do better than turn to the Apologie and Treatise of Ambroise Paré.

Paré's greatness was recognised in his own time. He served three French kings; he was spared on St Bartholomew's night; and he was one of the very few Europeans to be translated widely (even into Japanese) in the seventeenth century. His contributions to surgery were enormous. His instruments were not improved until the time of the Listerian revolution. He was the pioneer of modern artificial limbs, of modern brace-making, of the ligature in amputations and, though his credulity led him into the filthy morass of "wound-salves," he was the father of modern wound surgery as well. He gave a fine description of spinal cord compression, he introduced excision of the elbow, he recognised congenital scoliosis and, most important of all, his great influence was used to foster observation and experiment in surgery and to decry the blind acceptance of dogma.

Those of us who have had to read his works in unwieldy volumes which were too costly for us to own, will gratefully welcome a new English edition of all the better known writings, beautifully produced and edited with great scholarship, printed most admirably in good type and on good

paper, compact, handy and very cheap. The illustrations are commendable and the index is adequate. If this volume, the first of a series styled "The Classics of Science," is typical of its successors, we will be even more grateful. The fact that this book is edited by Mr Keynes speaks for itself. His introduction is an excellent concise account of Paré and of his significance.

The Apologie and Voyages occupy rather more than the first third of the book; the selections from the writings take the rest. The text is that of the standard English translation attributed (probably wrongly) to Thomas Johnson (1634). The original spelling is preserved. The selections contain nearly all the better known writings, including most of Paré's contributions to orthopaedics. It is, however, to the Apologie that one turns for the essence of Paré. Here, in a garrulous and gossiping defence of his methods which is as interesting as a well-written novel, Paré answers the attack of a leading academic physician, one Gourmelen, to whom he refers with delightful scorn as "my little master." Here is the experienced surgeon demolishing the armchair critic, and using an attack on his use of the ligature in amputations to give an account of his surgical methods and principles which has few equals for sheer interest. Here are the famous passages: the wounding of Captain Ratt ("I dressed him, and God healed him"), and the old soldier who, when hearing that three badly burned comrades had no hope of cure, "gently cut their throats without choler." Here is Paré's revolt against the barbarous surgery of the orthodox: "but I do not shew any such way of giving the strapado to men"; "I resolved with my selfe never so cruelly, to burne poore men wounded with gunshot," and so on. One could quote indefinitely. This book has given me more pleasure than I can tell.—D. Ll. Griffiths.

WOUNDS OF THE EXTREMITIES IN MILITARY SURGERY. By Oscar P. Hampton, Jun., M.D., F.A.C.S. Instructor in Clinical Orthopedic Surgery, Washington University, School of Medicine; Civilian Consultant to the Surgeon General, Department of the Army. 10 × 7 in. Pp. 434, with 131 figures. Index. 1951. London: Henry Kimpton. Price 70s.

When war is over the only anxiety of the temporary soldier is to get home as quickly as possible, for his urge is to return to sanity and gather together the threads of an earlier life. He feels that his experiences will not be repeated whilst he is alive and he has no desire to spend his time recording them. It always happens that the next generation in battle, being trained only in civilian practice, has to learn the lessons anew, and it is rumoured that this was so in Korea after but a few short years of comparative peace. Dr Hampton has, therefore, rendered a great service in recording in such detail his unrivalled knowledge of military surgery gained during the last war.

The treatment of the wounded man is followed, with the help of excellent illustrations, from the time of injury through all stages to the base hospital. The amount of information given is about equivalent to that in the Field Surgical Pocket Book (London 1950) but in a less concise form. An outline of reconstructive procedures is, however, included, but rehabilitation is hardly touched on in either book. Dr Hampton opens with general chapters on military surgery, first aid, primary and definitive surgery, vascular and nerve injuries, compound fractures, etc., followed by detailed regional descriptions. A most valuable feature is the emphasis he gives throughout to the main difference between military and civilian surgery—the military surgical team is not concentrated at a single centre but spread over a number of interdependent units on a long line of evacuation, treatment being progressive as the casualty is passed to the rear.

This will certainly become a standard text-book for U.S. Army Hospitals, but there are so many differences in detail from British practice, for example in the use of the tourniquet, the use of the Tobruk plaster, methods of amputation and the revision of wounds, that it is of less value to British Surgeons. One cannot help but wonder at the problems that will confront the Consultant Surgeon to an "integrated European army" should it ever come into existence—Philip Wiles.

LIPIDOSES. By Siegfried J. Thannhauser, M.D., Ph.D. Edited by H. A. Christian. Second edition. Pp. 612, with 125 figures. Index. 1950. London: Oxford University Press. Price 96s.

This book would not appear at first sight to be of interest to orthopaedic surgeons. But abnormalities of lipid metabolism often manifest themselves in bone, and the orthopaedic surgeon should know a little about them, if only to rid himself of a feeling of inferiority when they are being discussed. He is familiar as a matter of course with the commoner varieties, such as eosinophilic granuloma, Gaucher's disease, and the Schüller-Christian syndrome; but how many more of them are there? Nowhere will he learn about them better than from this classic, now in its second edition.—George Perkins.

ORTHOPÄDIE FÜR DEN PRAKTISCHEN ARZT. By A. Lorenz. 8¼ × 6 in. Pp. vii + 272, with 147 figures. Subject Index. 1949. Wien: Verlag Bruder Hollinek. Price $4.00.

The name Lorenz still has magic in it for an orthopaedic surgeon, and consequently one opens a book by the son of the great man with an excited shiver of pleasurable anticipation. But I must confess that I was disappointed. Although this is declared to be a book on Orthopaedic Surgery for General Practitioners, the material in it is neither selected nor illustrated in a manner appropriate to that purpose. I imagine that nothing could be more difficult than to write extensively on Orthopaedics for General Practitioners. The signs facilitating early detection would have to be emphasised; various alternative procedures would have to be correlated to clarify the broad underlying principles; details of technique would have to be avoided; and prognosis, particularly as to time and function, would be broadly indicated. If, on the other hand, the book is for orthopaedic surgeons, the relative merits of many procedures ought to be compared, preferences indicated, and details as well as broad principles meticulously discussed. Between these two stools falls the book of Dr Albert Lorenz. I can understand that he has had to overcome great difficulties in matters of illustration and printing of radiographs, and so I refrain from adverse comments in these respects; but it is difficult to overlook inverted radiographs, abstruse diagrams, archaic procedures, and emphasis of very rare or grotesquely extreme conditions. Perhaps, with the return of the freedom and culture for which his country was so justly renowned, when Dr Lorenz is able to publish as he would like, his pleasure will be equalled by ours.—Bryan McFarland.

SURGICAL TREATMENT OF THE MOTOR-SKELETAL SYSTEM. Supervising Editor, Frederic W. Bancroft, A.B., M.D., F.A.C.S. Professor of Clinical Surgery, New York Medical College. Associate Editor, Henry C. Marble, A.B., M.D., F.A.C.S. Consultant, formerly Chief of Fracture Service, Massachusetts General Hospital. Second edition. Two volumes. 10 × 7¼ in. Pp. 1,303, with 1,049 figures and 3 colour plates. Index. 1951. Philadelphia, London, Montreal: J. B. Lippincott Company. Price £9, 9s.

In the preparation of the second edition of this comprehensive compendium edited by Dr Bancroft, Dr Henry C. Marble succeeds the late Clay Ray Murray as associate editor. No less than forty-eight surgeons are listed as contributors and, although all are of the highest surgical distinction, it is not unnatural that their literary ability should vary. In a brief review it is not possible to do justice to each section. Some of the chapters are outstanding and the general average is high, but there are a few that "date" their authors, and there are a few that are only a catalogue of diseases with little discussion of treatment; there are also a few authors who give undue emphasis to eponymous operations.

It is rather unkind to offer a general criticism of a work that has involved so great a labour by so many people. Symposia of this type have limited value. They lack the personality and balance of a book by a single author and, however brilliant may be the contribution of an individual surgeon, they suffer from the limitations imposed by the editor's choice of title and his allotment of the available space. The details of specialised subjects are of little value to the general surgeon, and the specialist often prefers to gather his information from original sources.—Philip Wiles.

MARKNAGELUNG NACH KUNTSCHER. By Carl Habler. Second edition. 9 × 6½ in. Pp. xvi + 302, with 154 figures. 1950. Munich and Berlin: Urban & Schwarzenberg. Price DM. 26.

This, the second edition of a book that originally appeared in 1944 under the title of "Stable Osteosynthesis," is based on the end-results of medullary nailing in over 900 cases—many of them of war injuries—which can now be properly summed up in retrospect. Though Professor Häbler feels that he may be accused of some decline in his initial enthusiasm for the method, English-speaking readers will still find his applications of Küntscher's technique very catholic indeed, with an emphasis on closed operation under fluoroscopic control which is by no means universally accepted. Thus pride of place is given to the fifty pages describing closed nailing of the femur; and indeed it is clear that in the skilled hands of some German surgeons the accurate reduction of limb fractures on special traction tables and closed nailing with repeated short radioscopy may offer a most satisfactory solution to some of the most difficult fractures. There is less enthusiasm for open retrograde nailing.

This is essentially a book for the practising surgeon who wishes to know exactly how to operate on a particular long bone; the types of fracture that can safely be nailed, and precise instructions about reduction, armamentarium and technique, are set out in each case. What is not so clearly stated is the indication for preferring medullary nailing to conservative, or some other form of operative, treatment. But it is only fair to say that Professor Häbler, though practising the method widely himself, loses no opportunity to warn surgeons of their responsibility for the tragedies which may follow improper indications and technique. There are some interesting sections on the help afforded by nailing in osteotomy and bone-shortening operations. Text and illustrations are excellently produced.—David Le Vay.

LECCIONES DE FISIOPATOLOGIA Y CLINICA QUIRURGICA. By Francisco Martin Lagos, Professor of Surgical Pathology, University of Madrid. Second edition. 10 × 7 in. Pp. 712, with 178 figures. Index. 1950. Barcelona: Editorial Cientifico Medica. Price not quoted.

This is a revised and enlarged new edition of a book first published in Spain in 1942. In accordance with the medical education and training of its author—he had been a pupil of Lexer—this is a typically German book in all its ingredients, from its layout to its sources. As compared with its first edition, a marked improvement is noticeable in the number and quality of the Anglo-Saxon and other references which have been introduced, giving a more balanced view of the subjects described in its pages. Nevertheless there is still room for improvement, for instance in the section on osmotic regulation where the works of Hamburger, Schade, Magnus and Koranyi are mentioned but no reference is made to the outstanding contribution of Starling or of the profuse works of Landis. The same may be said of the section on wound treatment where the author, following closely the old German teaching of Friedrich, still discourages wound excision after six or eight hours from the time of wounding. It must be recognised, in spite of this criticism, that in many other places the experiences of the last war collected on the Allied side have been duly acknowledged.

The book describes extensively the clinical, biochemical and pathological features of congenital deformities, infections, trauma and tumours, studied from the point of view of a surgeon. Evidence of the profuse readings of the author is found in the large number of contributions mentioned in the text, but unfortunately there is not a single bibliographical reference or a bibliographical index. Some lack of proof reading has allowed excessive mistakes to be printed, such as Zenón for Zeno and Leveng for Leveuf.

In spite of these shortcomings this is a book worth reading, particularly by those who are insufficiently acquainted with the sources of modern German medical literature.—J. Trueta.

TEXT-BOOK OF SURGICAL TREATMENT, including Operative Surgery. Edited by C. F. W. Illingworth, C.B.E., M.D., Ch.M., F.R.C.S.E., F.R.F.P.S. (Glas.). Regius Professor of Surgery, University of Glasgow. Fourth edition. 10 × 6¼ in. Pp. xii + 744, with 381 figures. Index. 1952. Edinburgh: E. & S. Livingstone Ltd. Price 45s.

This well known all-Scottish symposium remains true to the tradition of general surgery in Scotland and covers the whole gamut of surgical disorders from appendicitis to congenital heart disease, from club foot to carcinoma of the rectum. It must be popular, if only amongst the examination-minded senior students for whom it is avowedly written, because in just nine years it has reached its fourth edition. However, the detail of treatment, with a few exceptions, is too sketchy to be of value in practice—for example, fractures are dealt with in forty-seven pages. The outsider cannot resist the conclusion that the labour of the many most able contributors has been misdirected, because, not unnaturally, they have found it impossible to discuss treatment without considerable reference to etiology and pathology. It needs only to expand the present volume by about one-third to make it a complete synopsis and provide, in a compact and readable form within a single cover, all the surgical knowledge the undergraduate needs for examination purposes.

In this fourth edition every chapter has been brought up to date, and valuable new sections have been added by Professor Walter Mercer on congenital heart disease (twenty pages), by Mr W. A. Mackay on arterial hypertension (fourteen pages), and by Mr A. R. Parkes on infection of the hand (ten pages). The production is in keeping with the high standard from which Messrs E. & S. Livingstone Ltd. never permit themselves to depart.—Philip Wiles.

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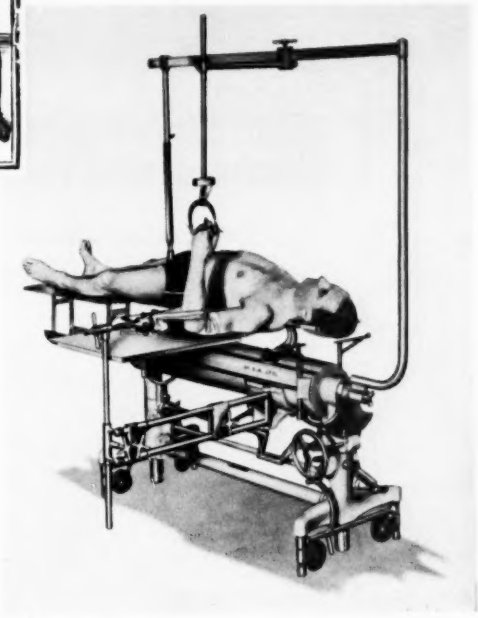

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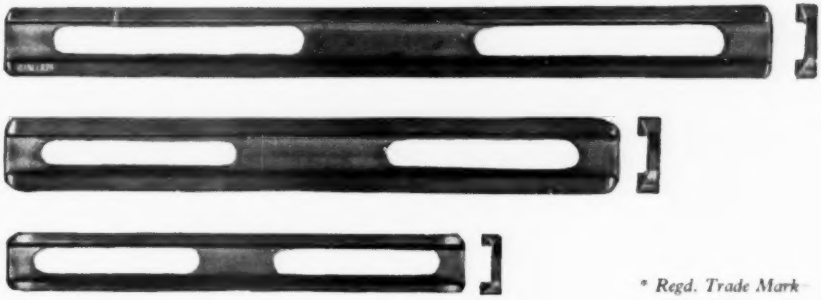

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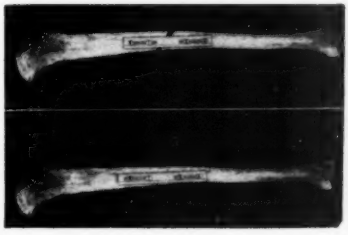

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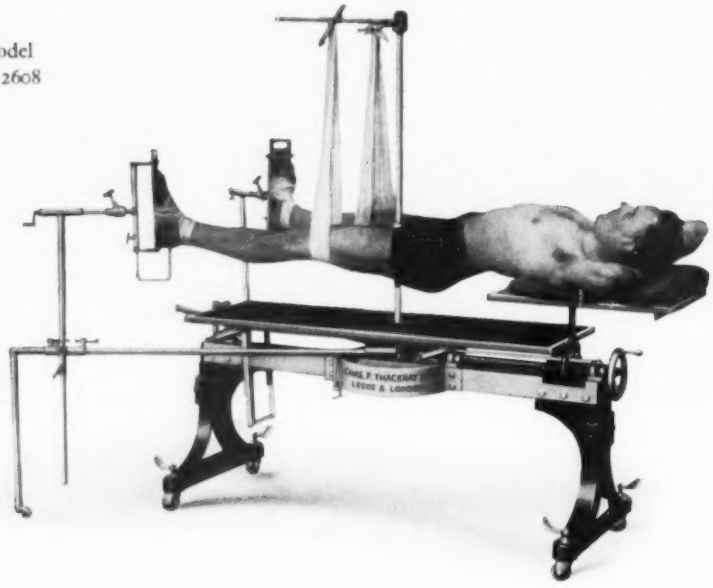

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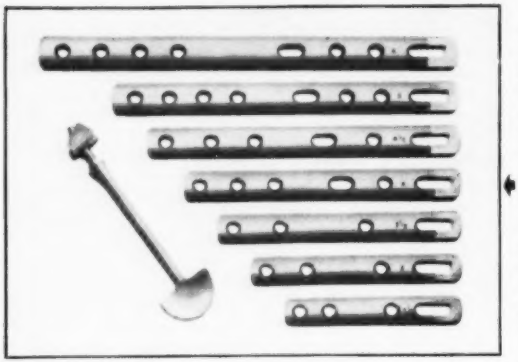

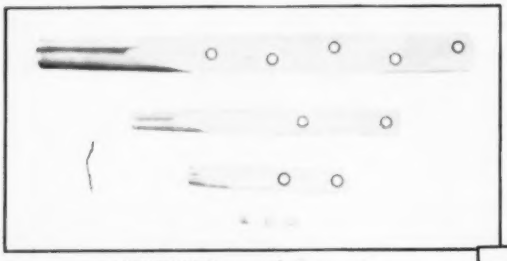

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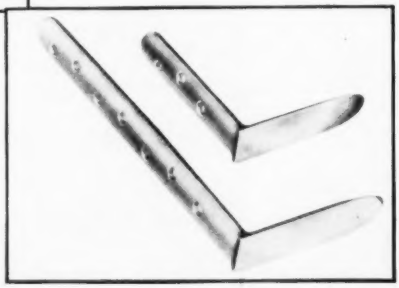

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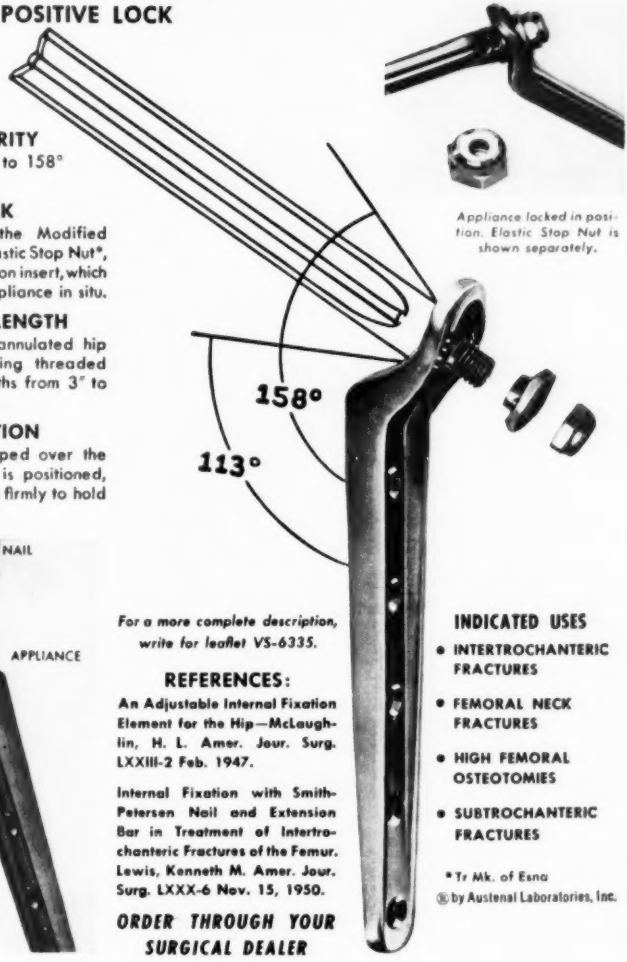

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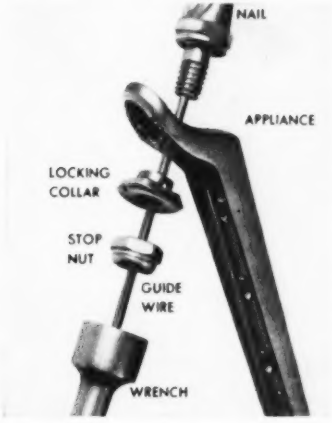

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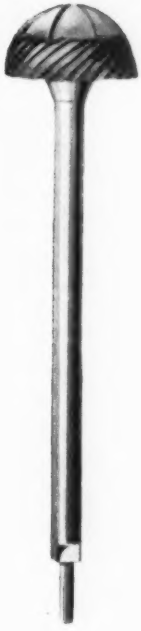

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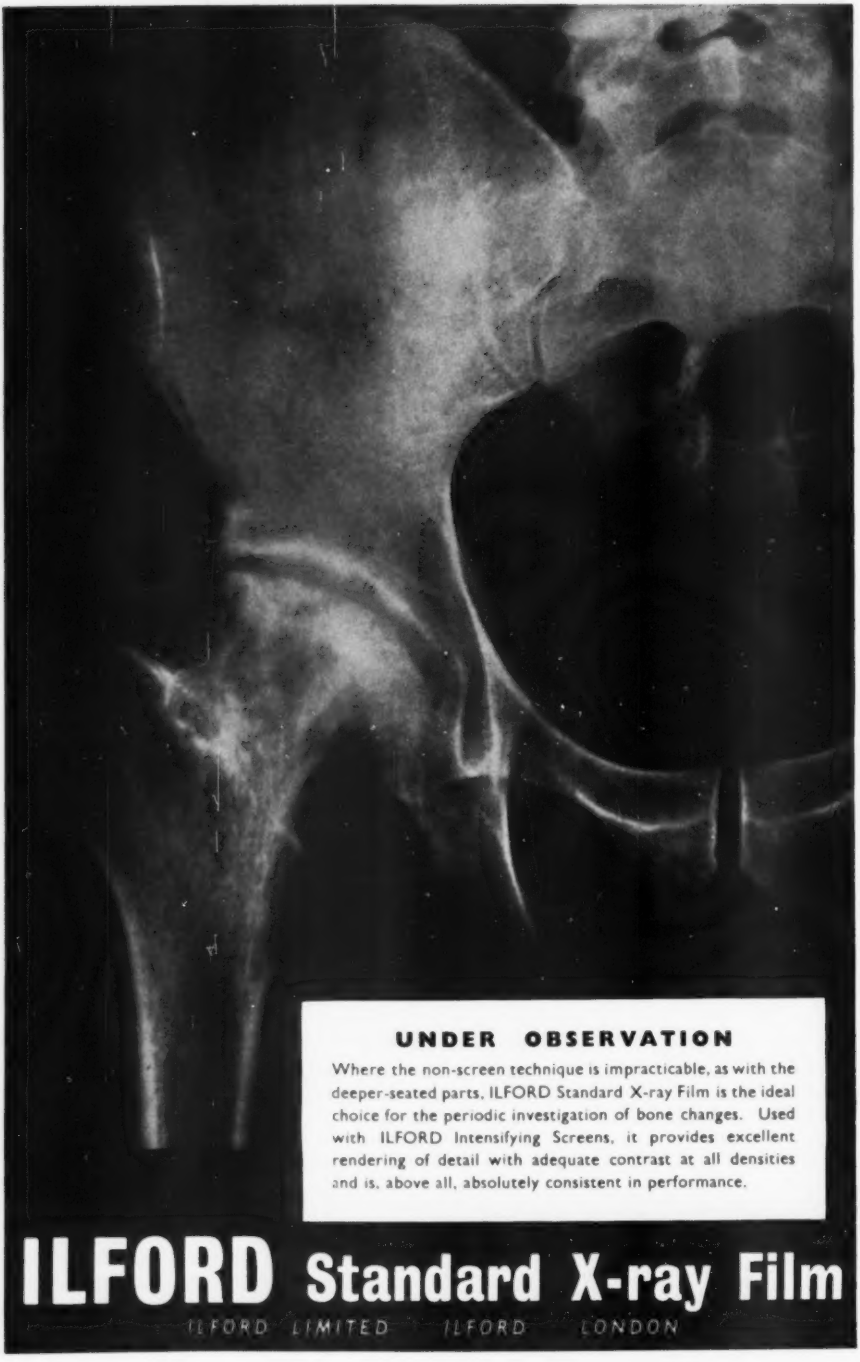
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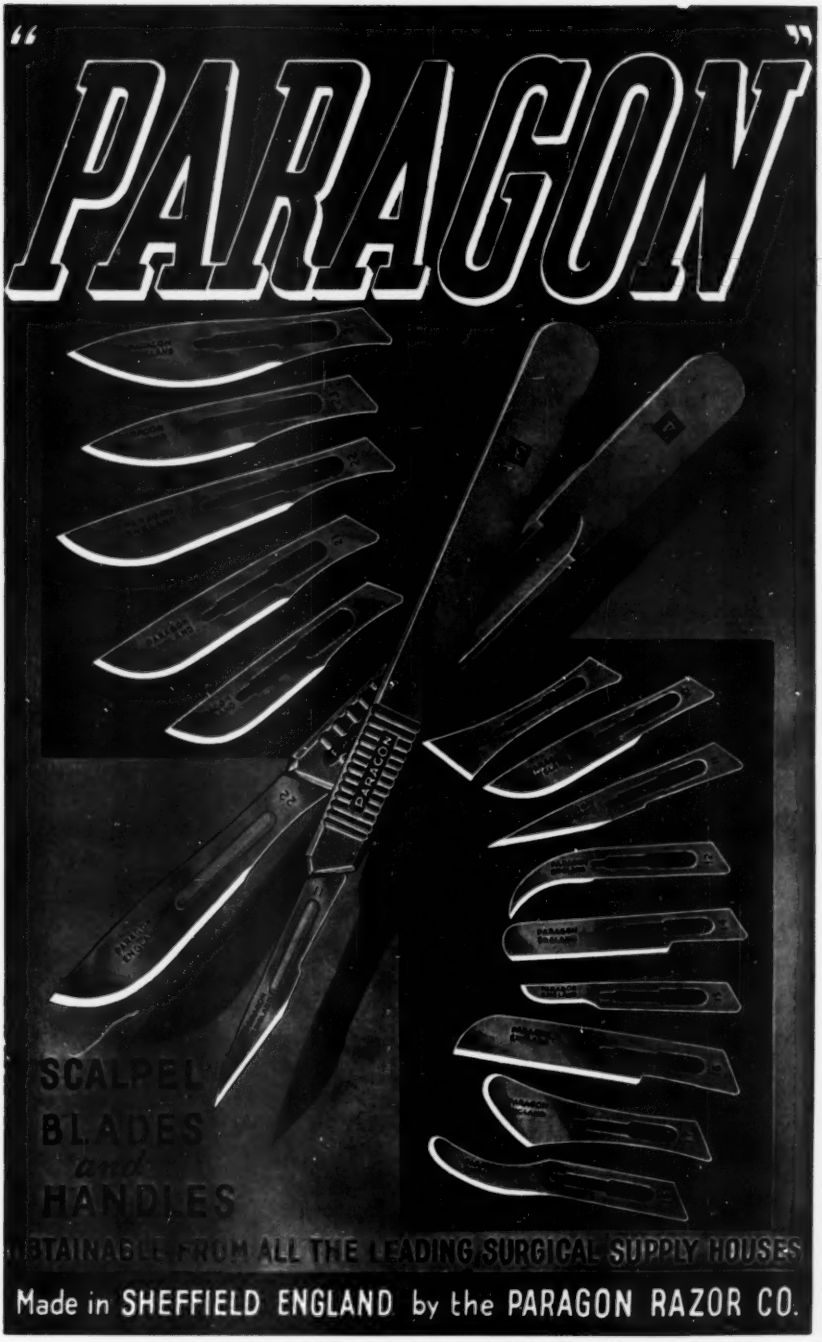
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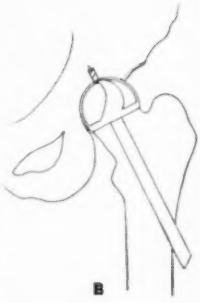

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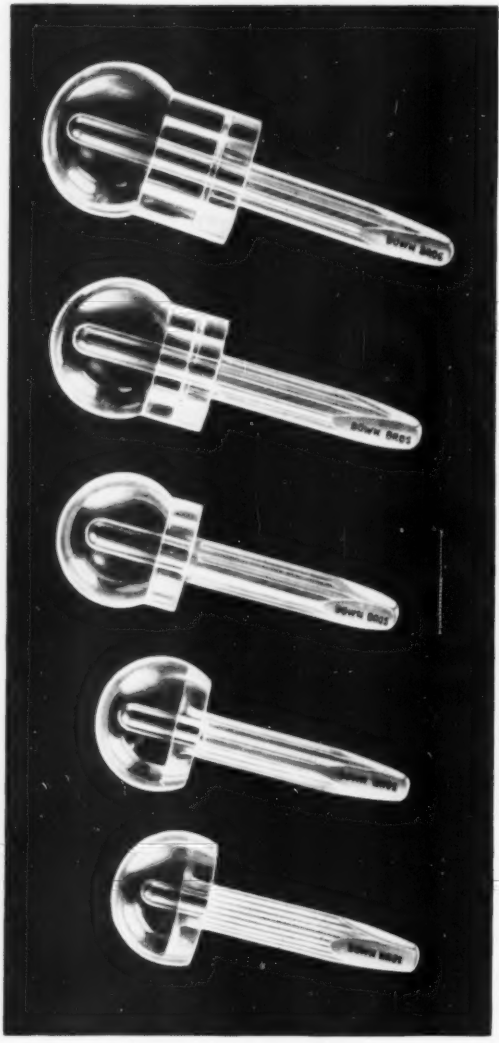

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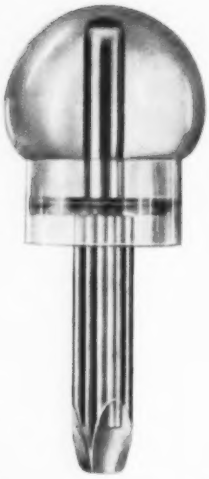

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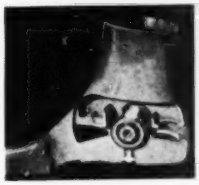

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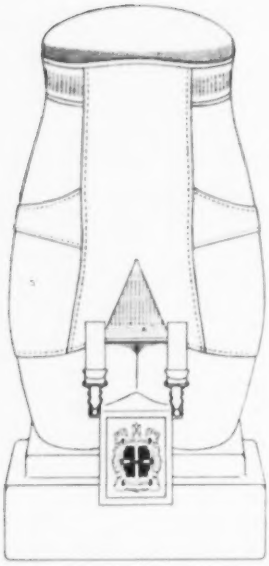

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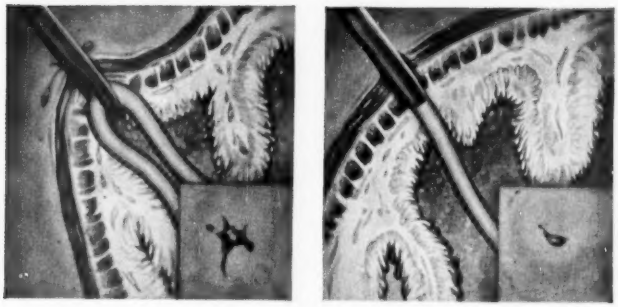

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The Journal of Bone and Joint Surgery is the official publication of orthopaedic surgeons of the Commonwealth of British Nations and the United States of America, and in this respect it represents the science and practice of orthopaedic surgery in the English-speaking world; but important orthopaedic contributions are also reported from every country in the world, and original articles will be welcomed from any contributor, wherever he may live. Facilities for translation will be made available.

We are also anxious to report the Proceedings of Colleges, Universities, Societies and Associations in every part of the world in so far as they contribute to the advance of orthopaedic surgery. A measure of international co-operation in publication has already been achieved and this will be fostered and, we hope, increased.

Manuscripts offered for publication in the British volume should be addressed to the Editor, Journal of Bone and Joint Surgery, 82 Portland Place, London. The Editorial Secretary of the Board is at the service of authors, and will assist in any way she can. Manuscripts offered for publication in the American volume should be addressed to the Editor, Journal of Bone and Joint Surgery, 8 The Fenway, Boston 15, Massachusetts. Manuscripts from surgeons in the United States should be submitted to the Boston Office, and manuscripts from surgeons in the British Commonwealth should be submitted to the London Office; only in special circumstances is this agreement between the offices altered.

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